Railway Mechanical Engineer

Vol. 101 November, 1927 No. 11

Appearing elsewhere in this issue is an article by "Sydney Dunn" in which he has discussed in an interesting way some very fundamental factors in the heat treatment of steel. "Sydney Dunn" is not the real name of the author of this article. Undoubtedly the value of the article would be considerably increased in the eyes of many of our readers if the author had chosen to sign his real name. He is, however, well known to the majority of railroad blacksmith shop foremen and it is for the special information of this group of men that this article was prepared. Heat treating is a comparatively new development from the standpoint of the blacksmith foreman in the railroad shop. It is the result of highly scientific research and experiment, but it must be applied by the practical man. Therefore, the blacksmith shop foreman must study the fundamentals of heat treatment, for it is evident that he must apply them whether he is willing to or not. Many of the fundamental rules discussed in the article are violated daily in blacksmith shops throughout the country. We hope the author will have more to say on the subject of heat treatment in future issues.

Some facts about heat treatment

Good housekeeping not only reduces accidents, but it is a big factor in increasing production and bettering the quality of production in any shop. Notwithstanding a general acceptance of this statement, many a shop foreman, who prides himself on knowing his job, is careless in this respect. Several years ago the superintendent of a southern railroad shop had a sign made which read, "This is the Dirtiest Place in this Shop." Each week he made a personal inspection at some unannounced time, after which he awarded the sign to the department he considered the dirtiest. The sign was displayed in some prominent location in the department until some other department received the "prize." Naturally, there was considerable rivalry among the foremen to avoid being thus honored.

Two ways to promote good housekeeping

Another method of securing good housekeeping, but of a different nature, was placed in effect in the shops of an eastern road the first of this year. All the sweepers work on a piece work basis, the rate being established on a certain floor area and the condition in which it is kept. In other words, the shop floor is divided into sweeping areas and each sweeper is assigned an area to keep clean. Each sweeper is paid according to the number of square feet in his area and by the quality of work performed.

Both of these methods of promoting good housekeeping have produced results in the shops where they have been tried out. Good housekeeping will only receive that attention from the men that those in charge of the shop demand, but a shop must first be made clean and sanitary before the men can be asked to keep it so.

Baseball has been known as the national game for a great many years and there is hardly a person in America who is not interested in the outcome of each world series game as it is played. Trying to enforce any rule which the men may have to violate in ascertaining the score during a world series is practically impossible in most shops and offices, and attempts to do so are causes of friction. It is a wise executive who accepts conditions which are inevitable and turns them to the advantage of the company. During the recent world series the management of one shop made arrangements so that all employees would receive the score at the end of each inning. A radio and loud speaker in the office supplied the information. On a number of banners carrying safety first slogans, the batteries for the two teams and the score at the end of each inning was written in large characters. These banners were carried through the shops after each inning by laborers, each covering a designated area. Observation showed that there was practically no time lost in production and there was every evidence that this action was keenly appreciated by the men in the shop.

What is the score?

General car loading conditions on American railroads are improving. Shippers as a rule are giving their hearty support to the efforts of the loading rules committee of the American Railway Association, Mechanical division, both in developing needed changes in the rules and particularly in living up to the present rules which represent years of the best thought and experience in the efficient loading of commodities. As with all other phases of railroad operation, however, there is room for improvement. By far a great majority of the shippers, both large and small, are at the present time observing the loading rules without any special urge on the part of railway officers. A considerable number, however, do not understand the necessity for and methods of correct loading and there are a few who insist on loading and bracing shipments in accordance with their own ideas either becuse they consider their methods better or because they cost less. The last named group sometimes use their business as a club to compel the acceptance of shipments with non-standard

Loading rule observance

loading under threat of giving the cars so loaded to a competing carrier. It was expressly stated on the convention floor at the recent annual meeting of the Railway Car Department Officers' Association at Chicago, that in not a few cases railroads have thus accepted shipments actually rejected by other roads on account of non-compliance with the loading rules. Such a situation, implying a breakdown of the rules, is indefensible and, if permitted to exist, the railroads have only themselves to blame. If each road in any given territory will firmly refuse to handle improperly loaded cars, even the most truculent shipper will be converted, and the chances are that a little experience with the loading rules will convince him of their merit from a safety standpoint even if they do not, as in some cases, actually permit heavier car loading then has been possible with former methods. Many claims for loss due to rough handling are in reality due to weak and inefficient bracing in non-conformance with the loading rules. Both shippers and carriers may well co-operate still further in an intensive effort to secure better loading of freight cars.

Properly protect the welders' eyes

The railroads were among the first of the larger industries to grasp the possibilities offered by autogenous welding and a large number of welders are now employed in railroad shops. In due course, the managements were confronted with the problem of adequately protecting the welders' eyes. The railroads, like other large users of welding processes, extended every effort to provide suitable screen glass to protect the eyes from permanent injury. Owing to the lack of sufficient knowledge on just what it was that caused injury to the eyes, all users were, in most cases, forced to purchase screen glass on a hit and miss basis. Within the past few years, however, much light has been thrown on this subject of which full advantage has not yet been taken. Some railroad shops are still using inferior screen glass to protect the eyes of the welders.

It has been found that the invisible infra red rays and not so much the ultra violet rays are those that cause the most serious damage to the eyes. The cheapest screen glass that can be purchased will filter out the ultra violet rays but not the infra red rays. How many railroads are still purchasing screen glass based on color density and thickness?

An adequate screen glass which will filter out the infra red rays does not depend on color density and thickness, but on the proper chemical content of the glass. Screen glass is now obtainable that will not only filter out the the infra red rays, but also have such a low color density that the welder can see the details of his work without removing his goggles or shield even in the absence of the light from the torch or arc. An efficient welding glass should not transmit more than one per cent of the dangerous infra red rays.

Even after welders have been supplied with the proper kind of screen glass, some of them still complain of eye trouble. When this situation arises, those complaining should have their eyes tested for inherent weakness. A car building plant recently had the eyes of about 4,000 of its employees examined and it was found that 37 percent of those examined had some sort of eye trouble. The best grade of welding glass now obtainable will not correct inherent eye defects or weaknesses and if such trouble is serious, the welder should be taken off the job. In some cases a pair of glasses can be worn under the welding goggles, but this is not an entirely satisfactory way of correcting the trouble, and the application of a suitable filter glass to the manufacture of optical lenses is now in process of development.

Machine tools and lubrication

Modern machine tools are purchased either to replace obsolete machines or to supplement existing machines to take care of the increase of the output demanded of the shop. To meet the requirements demanded by the purchaser, the builders have designed machines to meet output demands and to decrease production time. The result has been that some of the machine tool builders have directed all of their efforts to meet the production demands and have paid too little attention to those necessary functions which, while they are not directly productive, certainly contribute in a large measure to production. Lubrication is one of these necessary functions.

A machine tool, to be thoroughly modern, should include in its design an effective system of lubrication. A purchaser of a machine tool, in his effort to secure the other characteristics needed to meet the present requirements in his shop, may readily lose sight of the importance of an effective lubricating system. A machine with an inefficient lubricating system will meet the requirements for awhile because it is new. But later on, owing to excessive wear, it loses accuracy or some of the weakened parts break. In either case the machine must be repaired. This means loss of production time in addition to the cost of making the repairs. When buying a modern machine tool, it is well to determine beforehand that it has included in its design all of the refinements that will contribute to the continued maintenance of the quality and quantity of production originally expected over a long period of time. The most important of these refinements is an adequate lubricating system.

What about draft gears?

Hardly a more vexatious problem confronts railway car department officers than the question of what types of draft gears to order for specific classes of service and, at least equally important, what to do about the maintenance of existing gears. The commonly understood purpose of the draft gear tests, now being conducted under the auspices of the American Railway Association at Purdue University, Lafayette, Ind., is to develop the general characteristics of draft gears which will meet successfully American railroad operating conditions. This work is being conducted with an eye to the future and is of importance. But what about the two and a half odd million sets of freight car draft gears now in service?

Draft gears are in effect orphan parts of a car. Because of the fact that trains are not liable to run away or be derailed due to defective gears, the government does not take cognizance of draft gears under the Safety Appliance Act nor require current maintenance work and records as in the case of air brakes. Car men themselves in general do just as little work on draft gears as possible, and, owing to the inaccessibility of draft gears for inspection and repairs, it must be admitted that many cars leave repair shops and rip tracks having draft gears with a highly uncertain degree of efficiency, if any.

Draft gears need to be better maintained. No one

is in a position to say how urgent this need is because the total loss due to defective draft gears is buried in the great sum which the railroads spend annually for loss and damage claims and freight car maintenance. Probably more damage claims are due to defective draft gears than to any other one cause and, as regards freight car maintenance, there are probably few freight car repair shops in the country at which an experienced car man cannot walk down through the yard and point out those cars in which broken couplers, knuckles, draft sills, truck bolsters and other car parts are not directly chargeable to draft gears which have failed to function. If it is good policy to allow cars to run without assurance that draft gears are functioning, why spend money for the gears in the first place?

What is the answer? Should the railroads themselves take the initiative and make current inspection and repairs of draft gears at stated periods of three years or possibly five years, stenciling the date of last inspection on the car itself and making non-inspection a penalty defect under the interchange rules? Would such a plan be practical in view of the lack of uniformity in draft gear types, the varying kind and amount of draft gear service in cars of the same series over a stated period, and difficulty in determining draft gear conditions merely by inspection? The cost of such draft gear inspection and maintenance must also be taken into consideration, but it may be safely stated that whatever the cost, it will be far less than the amount now spent by the railroads for damage to freight cars and contents caused by defective gears. Do any of our readers believe they have solved this problem or do they believe they know how it can be solved? It is a question which should be discussed and our columns are open for that purpose.

Why do alloy steel parts fail?

The greatly increased capacity of modern locomotives has taxed to the limit the physical properties of straight carbon steel as a material for certain locomotive parts and the still greater increase in capacity which seems certain to be demanded of future motive power points to the necessity of adopting other grades of steel with greater strength and endurance for those parts that must withstand the increased stresses of higher powered units. Many roads have already attacked this problem by the adoption of alloy steels for such important parts as main and side rods, crank pins, axles, and piston rods. To say that this move has solved the problem successfully in all cases would be to ignore the fact that some railroads have had experiences with certain alloy steels that were so directly opposed to the results anticipated that they have abandoned the use of these higher grade materials and returned to the use of straight carbon steels. In doing so they have condemned, unjustly, a material that the trend in locomotive design seems to dictate must be adopted in the near future. The fact that some progressive railroads and the entire automotive industry have successfully utilized alloy steels leads to the conclusion that this material possesses highly desirable qualities. Why then have other railroads failed in their effort to take advantage of these qualities?

The problem of using alloy steels in locomotive construction is one of the selection of the proper grades, intelligent processing during fabrication and the still more important factor of their correct handling in service and maintenance. The successful use of any alloy steel is dependent upon first obtaining steel especially adapted to the service for which it is intended, of consistent analysis and physical characteristics, then on properly handling it during the forging process and finally on subjecting it to the correct heat treatment.

An alloy steel is a specialized product and a mill that has successfully produced straight carbon steel over a period of years is not, by virtue of that manufacturing experience, necessarily qualified to produce alloy steel any more than a locomotive builder, by virtue of years of mechanical manufacturing experience, is especially qualified to produce a successful motor car.

It is unfortunate, in the case of the railroads, that those alloy steels principally used in locomotive construction; namely, chrome-vanadium, chrome nickel and carbon vanadium are sensitive steels which react favorably or otherwise in direct relation to the accuracy of the several stages of the heat treating process. In adapting these materials the railroads were unprepared for their use by the absence of adequate heat treating facilities in their repair shops and of a trained personnel.

Assuming that the railroads must eventually adopt alloy steels for certain locomotive parts, it would seem that the problem can be materially simplified in its solution by a recognition of these factors: the purchase of alloy steel billets from manufacturers of recognized ability in the production of this specialized product; the installation of correct and adequate heat treating plant facilities and, most important of all, the addition to present forge shop forces of men trained in the handling of this comparatively modern material. Those roads that are successfully using alloy steels have accomplished satisfactory results through these methods while, on the other hand, those that have not succeeded may be forced to admit that failure has been due in part to the fact that the blacksmith foreman has been required to handle an unfamiliar metal with facilities so entirely inadequate that even a specially trained man could hardly hope for success.

New Books

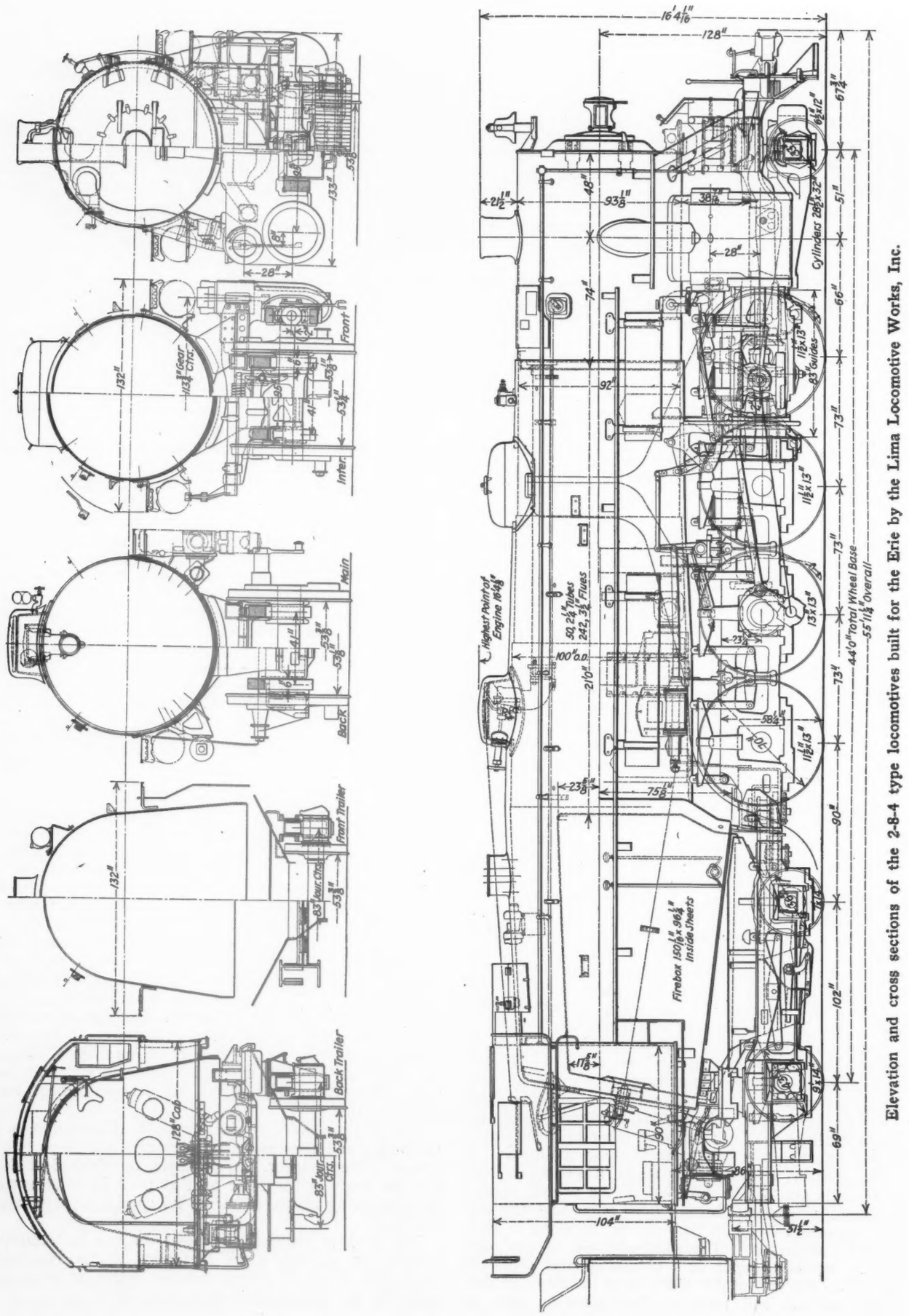
MACHINE WORK. *By Theron J. Palmateer. Published by the Stanford University Press, Stanford University, Cal. Cloth binding, 5 in. by 8 in., 212 pages, 215 illustrations. Price, single copy* $2.25, *lots of 10 or more,* $2.00.

Machine work, like any other school subject, can be better taught with the aid of a book than by the oral method only. The use of a suitable text in the shop relieves the instructor of repeating fundamental instructions, makes it possible for the student to work more or less independently and develops the student's interest and ability in technical reading. The problem has been to secure a text that can be used both as a shop manual and for reference. The present work is offered for this dual purpose. The text is divided into two parts, as follows:

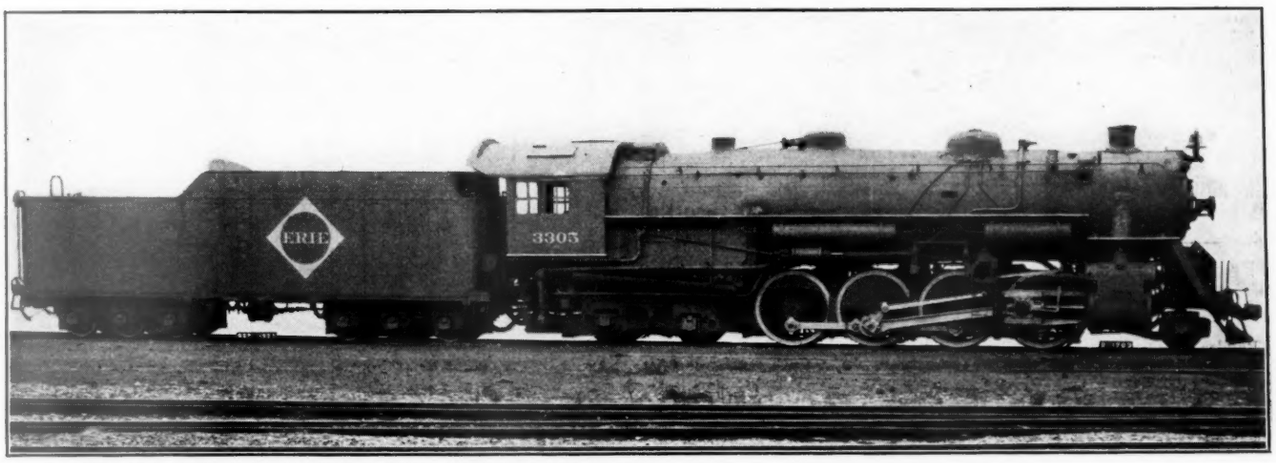
Part I: Fundamentals in lathe work, drilling, planing, milling and grinding—Detailed directions are given for making such practical pieces as mandrels, gears, face plates, vee-blocks, etc. Teachers of mechanical drawing, technical English and allied subjects will find the many illustrations, as well as the descriptions, of immediate value.

Part II: Quantity production work—Instructions for machining and assembling, in quantities, the 16 parts of a hand-power grinder. In principle, the method of doing the work is the same as that used in most small manufacturing shops, requiring no special or automatic machines.

The book is primarily intended for use in technical schools but contains much that may be constructively suggestive, if not of directly practical value, to those responsible for railway apprentice training.



Elevation and cross sections of the 2-8-4 type locomotives built for the Erie by the Lima Locomotive Works, Inc.



One of the twenty-five 2-8-4 type locomotives recently delivered to the ***Erie*** *by the American Locomotive Company*

Erie places 2-8-4 type locomotives in freight service

Designed to haul heavier trains at faster speeds— How increased tractive force was obtained

THE Erie has recently placed in service 50 locomotives of the 2-8-4 type, 25 of which were built by the Lima Locomotive Works, Inc., and 25 by the American Locomotive Company. While the two orders differ in certain features of the design and proportioning, the two builders worked together to the end that as many of the details as possible would be interchangeable.

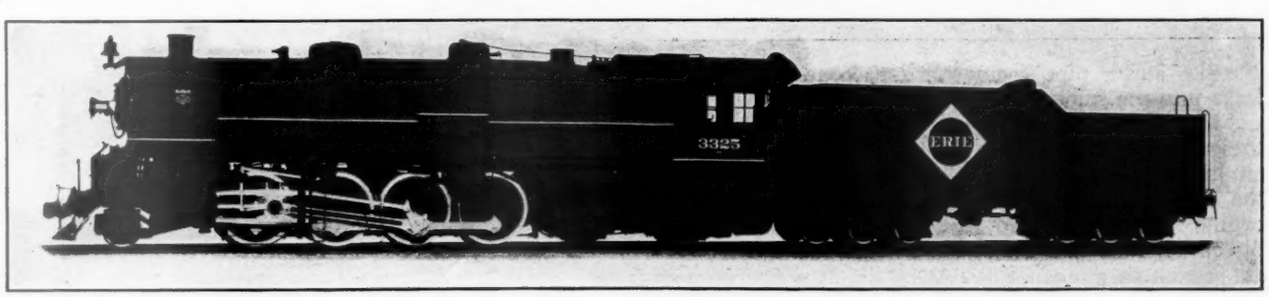
The Erie was faced with the necessity of moving over its main line heavier trains at greater speeds. Thus, the locomotives were designed with 70-in. driving wheels for attaining greater speeds than the Mikado and Santa Fe locomotives which the new engines will replace. The American built engines are being placed in main line service between Marion, Ohio, and Hornell, N. Y., a distance of 477 miles. The Lima built engines are in service between Marion and Meadville, Pa., a distance of 203 miles. In fast freight service some of the locomotives are being tried on continuous runs between Hornell, N. Y., and Marion, Ohio.

The American built locomotives weigh 443,000 lb. of which 276,000 lb. is on the drivers and 120,000 lb. on the trailing truck. They carry 225 lb. boiler pressure and, with a maximum cut-off of 80 per cent, develop a tractive force of 70,000 lb. Including the Franklin booster which drives the rear pair of trailing wheels, the total tractive force is 81,700 lb. The Lima built locomotives weigh 457,500 lb. of which 270,000 lb. is on the drivers and 131,800 lb. on the trailing truck. They carry 250 lb. boiler pressure and, with a maximum cut-off of 60 per cent, develop a tractive force of 72,600 lb. Including the trailer booster, the total tractive force is 85,000 lb. The adhesive weights and the 100-in. outside diameter of the boiler at the throat, on a center line 128 in. above the rail, indicate that advantage has been taken of liberal weight and clearance limitations.

The locomotives are alike in many respects

The locomotives built by both companies have the same wheel base, are designed for the same general service and are alike in many respects. The distribution of steam to the 28½-in. by 32-in. cylinders is controlled by the Baker long travel valve gear and the locomotives are equipped with the Precision reverse gear. The diameter of the front and trailing truck wheels and the length and diameter of all the journals are the same for both orders.

The principal firebox dimensions and the grate area



One of the Erie 2-8-4 type locomotives recently delivered by the Lima Locomotive Works, Inc.

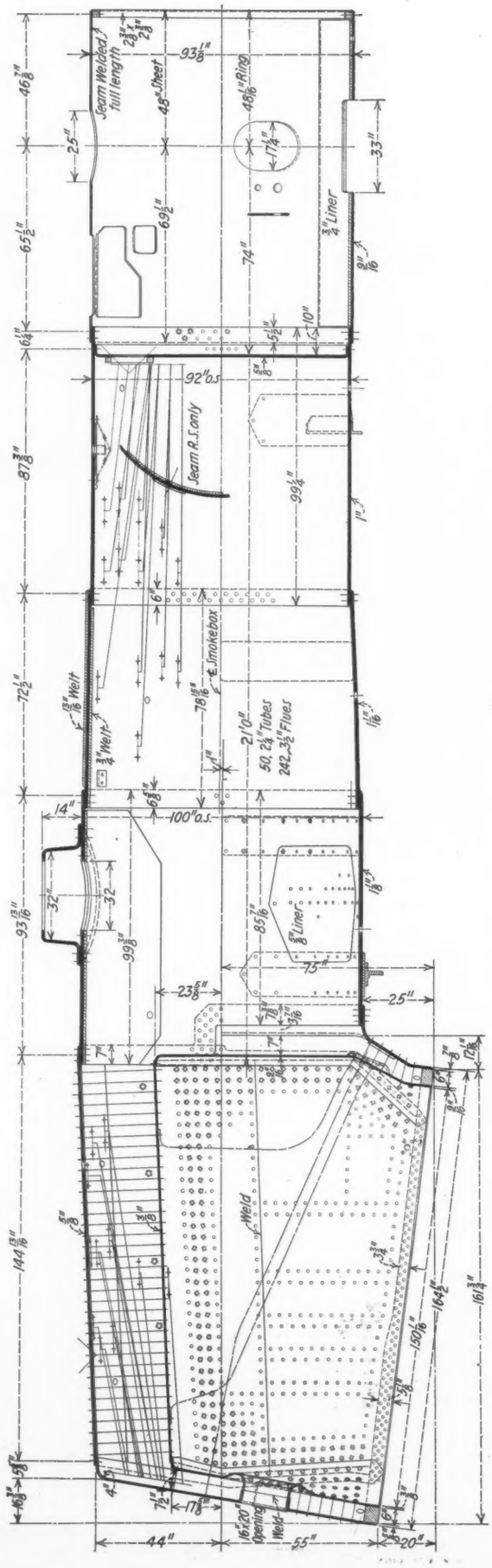
are the same and each firebox is fitted with two Nicholson Thermic syphons and an American brick arch carried on two arch tubes and the syphons. Mine-run coal is fed to the grates by Duplex stokers. The length between the flue sheets is 21 ft. and both boilers contain 243 3½-in. flues and 50 2¼-in. tubes. The Type E superheater with 112 units is used, the header of which contains the American multiple type throttle.

Principal dimensions and data of the Erie 2-8-4 type locomotives built by the Lima and American Locomotive Companies

Builder	American	Lima
Railroad	Erie	Erie
Type of locomotive	2-8-4	2-8-4
Service	Freight	Freight
Cylinders, diameters and stroke	28½ in. by 32 in.	28½ in. by 32 in.
Valve gear, type	Baker	Baker
Valves, piston type, size	14 in.	14 in.
Maximum travel	9 in.	9 in.
Outside lap	1¾ in.	2⅝ in.
Lead in full gear	¼ in.	¼ in.
Cut-off in full gear, per cent	80	60
Weights in working order:		
On drivers	276,000 lb.	274,000 lb.
On front truck	47,000 lb.	51,700 lb.
On trailing truck	120,000 lb.	131,800 lb.
Total engine	443,000 lb.	457,500 lb.
Tender	310,500 lb.	309,000 lb.
Wheel bases:		
Driving	18 ft. 3 in.	18 ft. 3 in.
Rigid	12 ft. 2 in.	12 ft. 2 in.
Total engine	42 ft.	44 ft.
Total engine and tender	86 ft. 2¼ in.	86 ft. 7¾ in.
Wheels, diameter outside tires:		
Driving	70 in.	70 in.
Front truck	33 in.	33 in.
Trailing truck	36 in., 43 in.	36 in., 43 in.
Journals, diameter and length:		
Driving, main	13 in. by 13 in.	Same
Driving, others	11¼ in. by 13 in.	Same
Front truck	6½ in. by 12 in.	Same
Trailing truck	7 in. by 14 in. and 9 in. by 14 in.	Same
Boiler:		
Type	Straight top	Straight top
Steam pressure	225 lb.	250 lb.
Fuel	Bituminous	Same
Diameter, first ring, inside	90 in.	92 in.
Firebox, length and width	150 in. by 9¼ in.	Same
Height mud ring to crown sheet, back	76⅝ in.	72⅝ in.
Height mud ring to crown sheet, front	96⅝ in.	98⅝ in.
Combustion chamber length	None	None
Tubes, number and diameter	50, 2¼ in.	Same
Flues, number and diameter	242, 3½ in.	Same
Length over tube sheets	21 ft.	Same
Tube spacing	4¼ in.	Same
Flue spacing	3 in.	Same
Grate type	Rocking	Same
Grate area	100.2 sq. ft.	100 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	320 sq. ft.	320 sq. ft.
Arch tubes and syphons	129 sq. ft.	128 sq. ft.
Tubes	960 sq. ft.	616 sq. ft.
Flues	4,290 sq. ft.	41,633 sq. ft.
Total evaporative	5,699 sq. ft.	5,697 sq. ft.
Superheating	2,448 sq. ft.	2,545 sq. ft.
Comb. evaporative and superheating	8,147 sq. ft.	8,242 sq. ft.
Tender:		
Style	Rectangular	Same
Water capacity	16,500 gal.	Same
Fuel capacity	24 tons.	Same
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	62.2	59.8
Weight on drivers ÷ tractive force	3.94	3.81
Total weight engine ÷ comb. heat. surface	54.5	55.5
Boiler proportions:		
Tractive force ÷ comb. heat. surface	8.6	8.73
Tractive force × dia. drivers ÷ comb. heat. surface	601	612
Firebox heat. surface ÷ grate area	3.20	3.20
Firebox heat. surface, per cent of evap. heat. surface	5.62	5.63
Superheat. surface, per cent of evap. heat. surface	42.9	44.7
Comb. heat. surface ÷ grate area	81.4	82.42

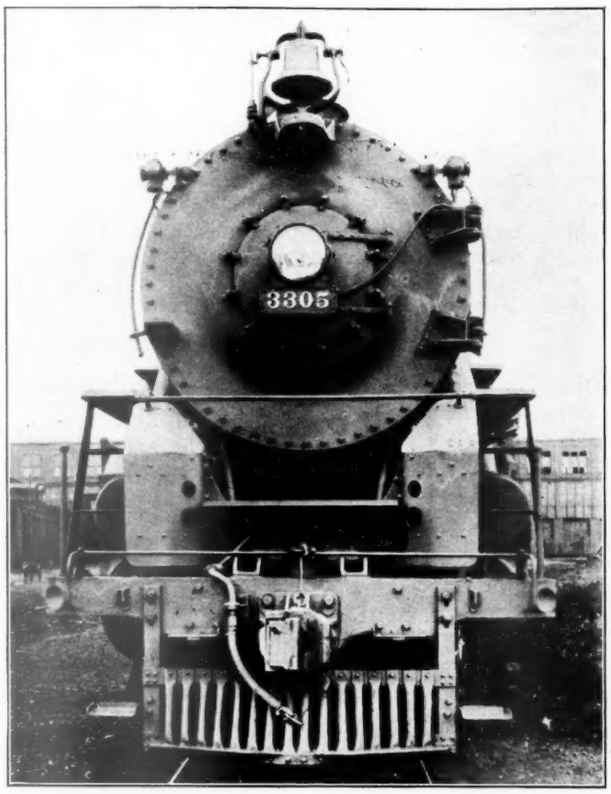
Flextite steam pipe casings are used to eliminate air leaks into the smokebox.

An unusual piping arrangement is used on all of these engines to distribute the superheated steam to the auxiliaries. The steam is distributed from a point on the outside of the smokebox on the left side of the engine. A 2-in. lagged iron steam supply pipe leads directly from a shut-off valve at the superheated header connection to a manifold. A 1½-in. lagged iron pipe leads from the bottom of the manifold and supplies steam to the two air compressors located ahead of the smoke-



Longitudinal section of the Erie locomotive boiler built by the Lima Locomotive Works, Inc.

box. Two ½-in. iron pipes lead from the manifold and pass under the jacket to the back head of the boiler. One of these pipes furnishes superheated steam to the turbo generator, to the preliminary booster throttle and to the stoker engine, and the other pipe furnishes steam to the Worthington feedwater pump. A 1¼-in. pipe



A front view of the Erie 2-8-4 type locomotive built by the American Locomotive Company

line leading from the shut-off valve at the smokebox supplies superheated steam to the blower line. The blower is operated in the cab by an extension rod in which are located two universal joints. A saturated turret is located just outside of the cab to supply steam to the stoker jet line, grate shaker, tank heater, the lubricators and the injectors.

The tender and cab arrangement are alike

The rectangular type tenders which have a capacity of 16,500 gal. of water and 24 tons of coal, are equipped with Commonwealth water bottom frames and six-wheel trucks. The engine and tender are finished with Duco. The Franklin spring type radial buffer and unit safety drawbar is used between the engine and tender.

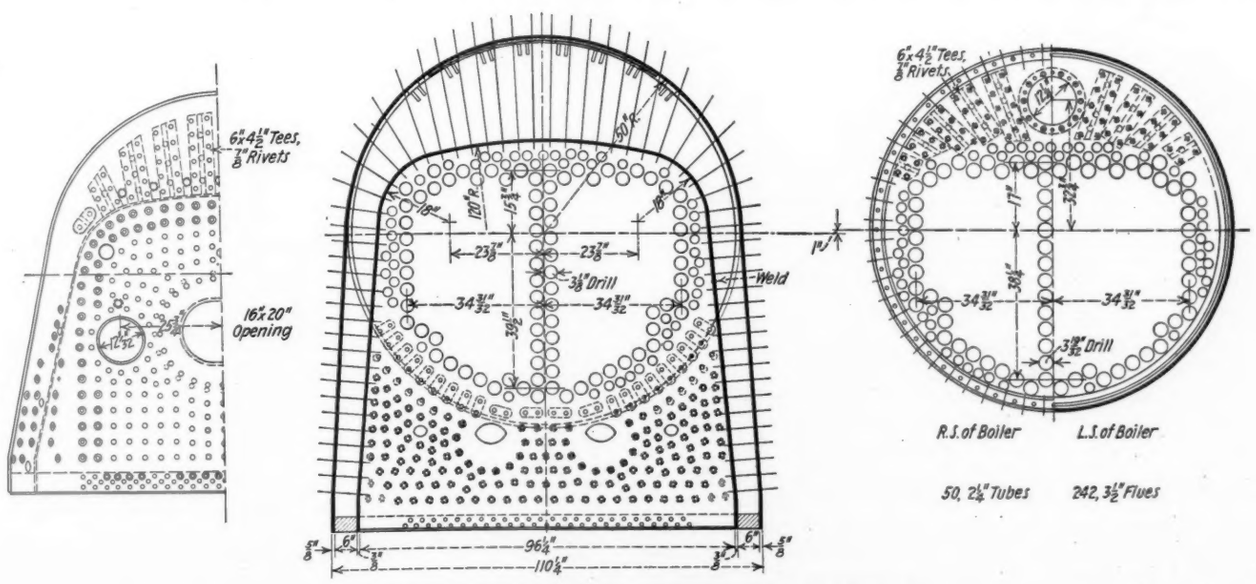
In arranging the control valves and equipment located in the cab, considerable attention has been given to provide for the convenience of the engineman. Of particular interest is the arrangement of the cab lights. Seven outlets are provided on the inside of the cab roof, three on the engineman's side and four on the fireman's side. Heavy, solid rubber cables lead from six of these outlets to the cast aluminum light fixtures which illuminate the faces of various groups of gages and the water columns. A long armored flexible cable leads from one of the outlets on the fireman's side to an extension light which may be carried to any location in the cab.

Wherein the locomotives differ

The first 2-8-4 type locomotives built by the Lima and generally known as the Lima A-1, was described on page 267 in the May, 1925, issue of the *Railway Mechanical Engineer*. This locomotive with the booster in operation developed a tractive force of 82,600 lb. The new Erie 2-8-4 locomotives built by Lima, the design of which is based on that of the A-1, develop under the same conditions, a tractive force of 85,000 lb. This additional tractive force, with larger wheels, was obtained by increasing the size of the cylinders and the boiler pressure. The grate area is the same, but the heating surfaces have been increased by additional flue length and by an increase in the number of flues and tubes.

The Lima engines are equipped with the articulated four-wheel trailing truck, the articulated main rod which delivers its load on two outside crank pins, and the compensating port arrangement by which an unbalanced cut-off has been obtained in the two ends of the cylinders at starting, with a resulting increase in the smoothness of the starting torque-curve.

On the American locomotives the Commonwealth Delta four-wheel trailer truck and cradle casting is used.



Cross sections of the Erie 2-8-4 type locomotive boiler

The Commonwealth ashpan was used by both builders. On the American built engines the ashpan is so arranged that it can be removed without dropping the trailer truck. The difference in the type of trailer trucks changed the dimensions from the rear driving axle center to the face of the radial buffer on the two designs. The distance between the trailer truck axle centers on the American engines is 78 in. and on the Lima, 102 in. The distance from the center of the rear trailer truck axle to the face of the radial buffer on the American

The interior of the cab showing the arrangement of the light fixtures

engines is 94 in. and on the Lima engines, 75½ in. The distance from the front of the firebox ring to the center of the rear driving axle for the American engines is 40 in. and for the Lima engines is 48 13/16 in. Thus, the boilers on the American built engines were set 8 13/16 in. farther ahead on the driving wheel base.

The total evaporating surface of 5,699 sq. ft. in the American built engines is made up of 960 sq. ft. in the tubes and 4,290 sq. ft. in the flues, 129 sq. ft. in the arch tubes and syphons and 320 sq. ft. in the firebox. The superheating surface is 2,448 sq. ft. In the Lima built engines the total evaporating surface of 5,692 sq. ft. is made up of 616 sq. ft. in the tubes and 4,633 sq. ft. in the flue, 128 sq. ft. in the arch tubes and syphons and 320 sq. ft. in the firebox. The superheating surface is 2,545 sq. ft.

The principal weights, dimensions and proportions of both locomotives are given in the table.

Cost of blowdown of boilers

By R. A. Tanner

Assistant engineer, Northern Pacific, St. Paul, Minn.

WHEN ordinary water containing impurities is used in a boiler some of the water will be exhausted as steam while the solids remain. As new feed water is added, more and more solids will accumulate in the boiler and a part of these solids, depending upon the character of the water, will precipitate and form sludge and scale. When the dissolved and precipitated impurities reach a certain concentration it becomes necessary to blow down the boiler, so as to prevent foaming or forming of scale, or both. The concentration that may be called the blowdown point, and practically, it becomes identical with the foaming point of alkaline waters.

As new feedwater is added to replace the blowdown water, the concentration will be slightly below the blowdown point, gradually increasing as steam is used and additional feedwater is admitted, until it again becomes necessary to blow down the boiler.

The blowdown point will vary considerably with the different waters, load conditions, etc., and may also be influenced by the use of anti-foaming compound. But for this discussion it is sufficient to assume that it lies between 3,000 and 15,000 parts per million, i.e., 175.4 to 877.2 grains per gal.

It may be assumed that the same amount of steam will be used during identical locomotive runs, and that the feedwater is partly used to replace the steam loss and partly wasted as blowdown.

In order to determine these amounts, let it be assumed that a quantity V of feedwater contains S solids per unit, or a total of VS solids.

If the blowdown point is F then a quantity

$$(1)\quad W = \frac{VS}{F}$$

will be concentrated to this point and must be blown off, leaving a quantity

$$(2)\quad V' = V - W$$

than can be utilized as steam. From (2) we have $V = V' + W$ and inserting the value of W from (1) we have

$$V = V' + \frac{VS}{F}$$

from which

$$(3)\quad V = \frac{F}{F-S} V'$$

the quantity of feedwater required, and

$$(4)\quad W = V - V' = \frac{V'F - V'(F-S)}{F-S} = \frac{S}{F-S} V'$$

the quantity of feedwater blown off.

These formulas are well illustrated by considering the two extremities. If the feedwater is pure, i.e., contains no impurities ($S=0$) then no blowdown is required ($W=0$), and steam can be produced of all the feedwater ($V=V'$). But if the feedwater contains as much impurities as the blowdown concentration of the boiler water ($S=F$), then all the feedwater must be blown off ($W=V$) and no steam can be used ($V'=0$), regardless of the amount of feedwater admitted.

The available tables for determining the cost of blowdown fail to take into account that the total amount of feedwater for a given run under otherwise identical conditions will vary with the amount of impurities. To correct this omission the following formulas and diagrams are based upon $V'=1000$, i.e., the cost of blowdown per 1,000 gal. of water, 8,340 lb. of steam actually used.

Each gallon of water blown off represents a heat loss of 8.34 $(t-t')$ B.t.u., where t is the temperature of the blownoff water and t' is the temperature of the feedwater as delivered to the tender; t is obtained directly from the steam pressure tables. If E is the efficiency of the boiler, then $\frac{8.34\ (t-t')}{E}$ is the amount of heat units actually furnished by the fuel. If P is the cost of fuel per unit and B is the number of B.t.u contained in a unit of fuel, then the loss of heat per gallon of blown off water is

$$(5)\quad C' = \frac{8.34(t-t')P}{EB}$$

The blown off water also represents a loss C'' equal to the cost per gallon of the water as delivered to the tender, including pumping, treating, anti-foaming com-

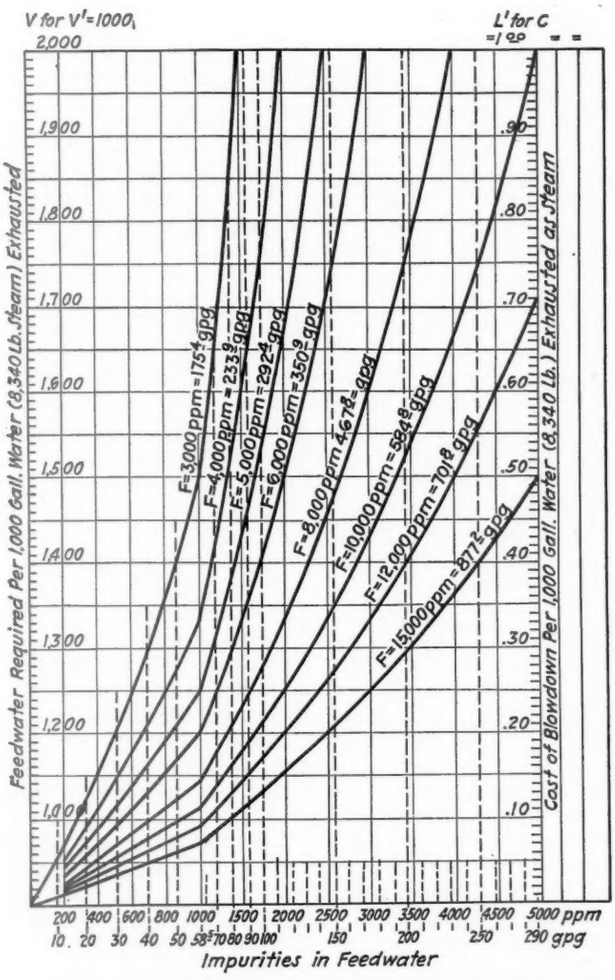
pound, etc., which can be obtained from the water-station and engine records.

The loss through blowdown is then $C'+C''$ per gallon blown off, and the total loss

$$(6)\quad L = W(C' + C'')$$

Inserting the value of W from (4) we have,

$$(7)\quad L = \frac{S}{F-S} V'(C'+C'')$$



Graph showing the cost of blowdown of boilers

and if V' is taken as 1,000 and the term $V'(C'+C'')$ is denoted by C, then the cost of blowdown is

$$(8)\quad L' = \frac{S}{F-S} C$$

per 1,000 gal. of water (8,340 lb. of steam) actually exhausted. Equation (8) permits direct comparison of the cost of blowdown of various waters under otherwise similar conditions.

It may, sometimes, be practicable to recover part of the heat of the blown off water for heating the feedwater. This may effect a saving in live steam otherwise used in the feed water heater, and a corresponding credit should be given to the blowdown cost; or it may raise the temperature of the feedwater and a higher value should then be given to t' in equation (5).

No credit, however, can be given to the blowdown cost for any heat and water recovered in the boiler washing plant, as the boiler washing is an additional expense chargeable to the impurities of the water, and the credit for heat and water recovered should go to the boiler washing plant.

In the graph are shown several curves for various values of F and additional curves may be constructed by interpolation or calculation to fit local conditions. The cast L' of the blowdown is based upon $C=1$, and for any other value of C the cost L' is obtained by multiplication with the new value of C; additional column for L' may be incorporated for frequently recurring values of C.

The following example illustrates the use of the diagram:

V = gal. of feedwater per 1,000 gal. water used as steam
V' = 1,000 gal. of water = 8,340 lb. of steam exhausted
F = 5,000 p.p.m. = 292.4 g.p.g. blowdown point (selected by experience)
S = 1,000 p.p.m. = 58.5 g.p.g. solids in the feedwater (by analysis)
P = $0.0016 corresponding to $3.20 per ton of coal
B = 11,000 B.t.u. per lb. of coal
E = 0.5, efficiency of boiler in decimals
t = 388 deg. F., boiler water under 250 lb. steam pressure
t' = 38 deg. F., water as fed to tender
C'' = $0.00015 per gal. of water in tender (from records)

Then:
$$V = \frac{F}{F-S} V' = \frac{5{,}000}{5{,}000-1{,}000}\ 1{,}000 = 1{,}250 \text{ gal.}$$

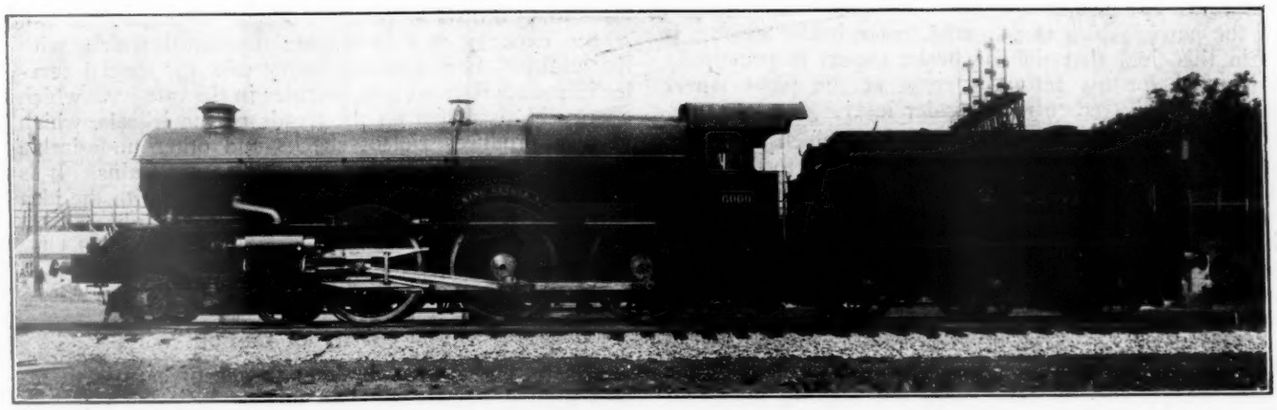
$$W = \frac{S}{F-S} V' = \frac{1{,}000}{5{,}000-1{,}000}\ 1{,}000 = 250 \text{ gal.}$$

$$C = V'(C'+C'') = 1{,}000\ \left(8.34\frac{(t-t')P}{BE} + C''\right) =$$

$$1{,}000\ \left(\frac{8.34 \times 350 \times 0.0016}{11{,}000 \times 0.5} + 0.00015\right) = \$1.00$$

$$L' = \frac{S}{F-S} C = \frac{1{,}000}{5{,}000-1{,}000}\ 1 = \$0.25$$

From S=1,000 vertical to F=5,000, left V=1,250 gal. of feedwater, right L'=$0.25 per 1,000 gal. of water used as steam.



The "King George V," of the Great Western of England on exhibition at the Baltimore & Ohio centenary exhibition and pageant

Four-cylinder 4-6-0-type, developing 40,300 lb. tractive force. Cylinders, diameter and stroke, 16½ in. by 28 in. Diameter of drivers, 78 in. Steam pressure, 250 lb. Weight on drivers, 151,200 lb.

Proposed revision of braking power for freight cars*

Irregularities are principal cause of wheel failures—Simple remedy suggested

By F. K. Vial
Vice-president, Griffin Wheel Company, Chicago

AN inspection of the results of gross variations in the retarding force of various classes of freight cars indicates that the resultant heat energy causes damage to the treads of car wheels, resulting in a large economic loss. This damage is independent of car capacity; in fact, the greatest damage is found in special cars of small capacity where the braking power is greatest.

Many cars depart widely from the A. R. A. standard for braking power with no provision for inspection of braking leverage. There is no possibility of detecting these irregularities. Another variation arises from the effect of the type of wheel on the coefficient of brake shoe friction. The A. R. A. specification for brake shoes calls for a wide difference in this respect, which is not taken into consideration in the A. R. A. rules for the braking power of cars.

The maximum stresses in car wheels are developed by excessive brake action continuing over a considerable period of time. There is a great variation from car to car in regard to the amount of shoe pressure. The damage to the treads of wheels and the reduced factor of safety, on account of high working stresses in the plate of the wheels are not matters of chance but are determined by fixed laws that are under our control but have never received adequate consideration.

It is the purpose of this paper to point out the irregularities having a bearing on the subject, to show the effect of these irregularities and to suggest remedies. It is fortunate that the remedies can be applied without expense to the railroads.

The problem of freight car retardation

There are four divisions to the problem of retardation of freight cars:

First.—The means for the development and control of the power which is delivered to the brake levers. It is in this field that the air brake expert is principally interested for his activities cease at the point where power is delivered to the cylinder lever.

Second.—The lever arrangement which receives, transmits, multiplies and delivers the power to the brake shoes is of primary importance with respect to the amount of pressure that is delivered and yet no provision is made for the inspection of leverage and there is no means of knowing what levers were intended when the car was built or whether errors have been made in subsequent repairs. It is well known that the leverage of cars in daily use is such as to produce variations in braking power from 40 per cent to 80 per cent of the light weight and in some cases the braking power of one end of a car is radically different from the other, It is possible that certain levers are reversed when making repairs. There is no provision for detecting these errors. All triple valves are stencilled when last cleaned. No stenciling on the car indicates that the levers have been inspected and found to be correct.

Third.—The brake shoe, which receives the pressure, is designed to create friction which varies through a wide range according to the kind of shoes used and the kind of wheels to which they are applied. Much definite information has been obtained and recorded in the A. R. A. proceedings regarding the relative variation in the coefficient of friction. This data has never been applied to the rules for the braking power of cars.

Fourth.—The wheel receives the brake shoe pressure and forms the moving frictional surface. It also carries the energy of the moving train from the rail to the brake shoes where it is transformed into an equal amount of heat energy. The wheel acts as a reservoir for absorbing a large part of his newly formed energy. If the feature of irregularity in the transformation of moving energy to heat energy is ignored, the work of retardation becomes bunched in certain cars causing an abnormal absorption of heat energy by the wheel which disturbs its molecular structure causing internal stresses while the tread metal, through violent expansion and contraction, is being disintegrated. In addition to this extreme work, the wheel carries the load and gives it direction, besides transmitting the rail pull to the brake shoes where it is equalized by the pull of the brake shoe hanger. It is customary to pass the disposition of the heat energy by saying "it is dissipated into the air." This great force cannot be disposed of so easily.

The present recommended practice for the braking power of freight cars was formulated in the late seventies when all freight cars were very much alike; hence it was not difficult to produce comparatively uniform retardation. Since that time the 30-ton, 40-ton, 50-ton and 70-ton capacity cars have been developed which, with the addition of abnormally heavy cars for special service introduce decided irregularities in the rate with which energy is dissipated on the treads of the wheels, which in turn produces violent shocks and other undesirable conditions, especially when operating long trains. It is therefore, timely to review these conditions with the idea of standardizing the braking power of freight cars in such a manner that the average retardation will be increased and existing undesirable features largely removed.

The energy of motion

The purpose of the braking power of cars is to retard motion. Retardation of motion indicates a change in the form of energy. When the energy of motion is transformed into an equivalent amount of heat energy, motion ceases but the energy itself is still working in another form.

* Abstract of a paper read May 24, 1927, before the Air Brake Association Convention, at Washington, D. C.

A visible illustration of the magnitude of energy of motion is the case of a head-on collision, where energy is suddenly transformed into an agency of destruction which tears to pieces the very materials of which the locomotives, cars and track are composed. The same energy might have been transformed by the wheels into an invisible form of equal magnitude which, if uniformly distributed, would have brought the train to a standstill

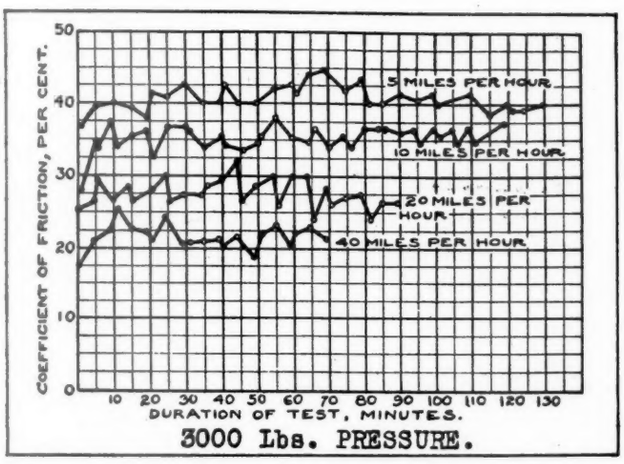

COEFFICIENT OF FRICTION, PER CENT.
5 MILES PER HOUR
10 MILES PER HOUR
20 MILES PER HOUR
40 MILES PER HOUR
DURATION OF TEST, MINUTES.
3000 Lbs. PRESSURE.

Fig. 1—Results of tests made at the Uniersity of Illinois in which the pressure and velocity and brake shoes were used under like conditions

in a few seconds with perfect safety. However, if the heat energy is irregularly distributed and the transformation too rapid, it will agitate the molecular structure of the wheel, producing violent temperature expansion commonly called "over-heating," the first visible evidence of which is the effect known as "brake burns."

The irregularity in the distribution of heat energy is more responsible than any other single item for the 542

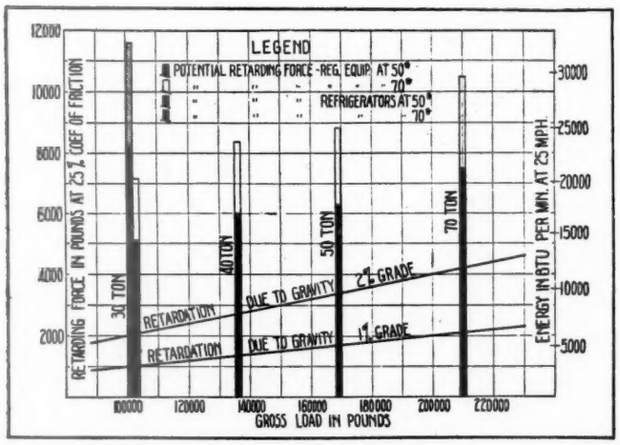


Fig. 2—The average retarding force for each capacity of freight car

derailments reported by the Interstate Commerce Commission during the past year and which were commented upon at the recent annual convention at Chicago of the Safety Section for the American Railway Association. Seventy-five per cent of such accidents can be eliminated without expense if the law between cause and effect is studied and a simple remedy applied. Among the items responsible for these irregularities are the variation in the coefficient of friction caused by the type of wheel to which the brake shoe is applied, extreme variation in the weight of cars, improper piston travel and undesired emergency application.

Coefficient of brake shoe friction

The retarding force of a car is the shoe pressure multiplied by the coefficient of brake shoe friction. The effect of the type of wheel on the coefficient of brake shoe friction was pointed out by Mr. Parke, in his paper before the New York Railway Club in 1897; from which the following extract was taken:

> A material reason why 70 per cent breaking power is best adapted to freight service, while a 90 percent braking power is best adapted to passenger service is the fully demonstrated fact that the friction of cast iron brake shoes upon cast iron wheels in freight service is materially greater than the friction of the same shoes upon steel tired wheels in passenger service.

Years of subsequent testing on the brake shoe machine by the M. C. B. Association at Purdue and by the American Brake Shoe Company at Mahwah, N. J., using fourteen different kinds of brake shoes under various pressures, stopping from 40 m.p.h. in the case of the chilled tread wheel and 65 m.p.h. in the case of the

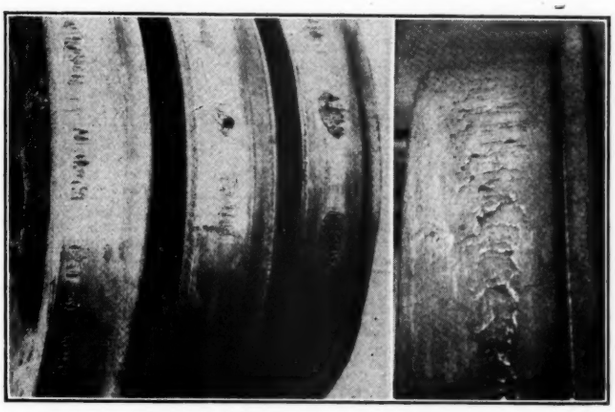


Fig. 3—Brake burns caused by excessive braking power

steel wheel, resulted in the following average coefficients for all brake shoes.

Shoe pressure, lb.	Chilled tread wheels, per cent	Steel wheels, per cent
2,808	23.6	17.7
4,152	21.4	15.3
6,840	18.5	13.3

These tests were the basis for the A. R. A. specifications for brake shoes adopted in 1901 and revised in 1910, which definitely calls for a much higher coefficient

Table I—Averages for Diamond "S" brake shoes

Pressure in lb.	Average Coefficients for All Velocities: Chilled tread	Steel wheel	Per cent chilled over steel	Velocities m. p.h.	Average Coefficients for All Pressures: Chilled tread	Steel wheel	Per cent chilled over steel
500	31.8	26.3	20.9	10	38.2	33.2	15.3
1,000	30.6	24.4	25.4	15	34.1	25.4	34.2
1,500	27.4	23.4	17.0	20	28.6	22.0	30.0
2,000	26.5	21.5	23.2	30	23.7	20.3	16.7
2,500	27.1	21.5	26.0	40	22.6	18.7	20.9
3,000	25.8	20.3	27.0	50	22.2	17.8	24.7
Average	28.2	22.9	23.1		28.2	22.9	23.1

of friction when applied to steel wheels. This feature, however, has never been applied to the formula for the braking power of freight cars.

The latest tests in which the pressure and velocity and brake shoes were used under like conditions on a chilled tread wheel and on a steel wheel at the University of Illinois are shown in Table I, all of which cor-

roborate the correctness of the conclusions reached by Mr. Parke. These tests were made at a continuous uniform velocity as shown in Fig. 1.

The test results shown in Table I and Fig. 1 establish, with a very definite degree of accuracy, a variable in retardation which should be incorporated into the rules for determining the braking power of cars, having for its purpose the elimination of one large element in irregularity in the distribution of heat energy to car wheels.

Variation in weight of freight cars

The second variation is the weight of the car. A canvass was recently made of all railroads to determine the variation in the weights of different classes of cars of different capacities. Table II shows the classification by weight and braking power for freight equipment of the United States and Canada. From the classification in the table the following summary is obtained showing the extreme variation in the light weight of cars. The greatest variation occurs in cars of 30-ton capacity. The percentage of variation drops very rapidly as the capacity of the car increases:

From	Lb.	To	Lb.	Per cent variation
30-T flat car.....	20,000	Refrigerator car..	55,000	175
40-T flat car.....	27,000	Refrigerator car..	60,000	122
50-T flat car.....	33,000	Automobile car...	60,000	82
70-T ore car.....	40,000	Hopper	60,000	50

The average retarding force for each capacity of freight car is shown in Fig. 2. Also, the amount of

Kind of car	Number of cars	Range in weight Lb.	Average weight Lb.	Average braking power Lb.
Flat				
30-ton	30,900	18,000 to 32,000	26,300	15,780
40-ton	66,800	27,000 to 36,000	30,300	18,180
50-ton	38,900	32,000 to 43,000	37,400	22,440
Open top				
30-ton	23,200	26,000 to 35,000	28,400	17,040
40-ton	139,400	28,000 to 42,000	35,300	21,180
50-ton	784,800	29,000 to 54,000	40,700	24,420
70-ton	157,500	39,000 to 60,000	51,000	30,600
Stock				
30-ton	46,100	27,000 to 40,000	33,200	19,920
40-ton	49,500	32,000 to 48,000	38,700	23,220
50-ton	2,600	44,000 to 46,000	45,000	27,000
Plain box				
30-ton	281,400	26,000 to 42,000	34,500	20,700
40-ton	560,600	32,000 to 49,000	40,100	24,060
50-ton	187,200	38,000 to 49,000	46,300	27,780
Auto. and furn.				
30-ton	12,300	34,000 to 46,000	38,900	23,340
40-ton	98,900	38,000 to 54,000	43,600	26,160
50-ton	48,900	44,000 to 58,000	50,800	30,480
Special box				
30-ton	52,300	35,000 to 42,000	37,300	22,380
40-ton	20,800	41,000 to 46,000	43,400	26,040
50-ton	1,500	48,000 to 52,000	50,000	30,000
Tank				
30-ton	19,700	30,000 to 40,000	35,200	21,120
40-ton	60,000	32,000 to 49,000	42,000	25.200
Refrig.				
30-ton	84,600	36,000 to 58,000	49,200	29,520
40-ton	62,300	51,000 to 63,000	55,500	33,300

Table II showing the classification by weight and braking power of freight cars in the United States and Canada

retarding force required to overcome the effect of gravity on a 1 per cent and 2 per cent grade. The particular irregularity is the excess braking power of refrigerator cars which even exceeds that of the 70-ton car. The effect of this excessive braking power in trains made up of miscellaneous cars is well known.

The effect of piston travel

The third item of irregularity is produced by variations in piston travel. The result of this irregularity is best shown in Table III.

Table III—Retarding force in pounds for service reductions of 10 lb. at 20 m.p.h. for various piston travels—90 lb. brake pipe pressure

Weight of car	Braking power at 84 per cent, at 70 per cent, lb.	Dia. of cyl., inch	8 Inch Chill	8 Inch Steel	6 Inch Chill	6 Inch Steel	4 Inch Chill	4 Inch Steel	Emergency Chill	Emergency Steel
20,900	17,556	8	1,578	1,214	2,367	1,821	3,730	2,869	5,021	3,862
32,250	27,090	8	2,435	1,873	3,653	2,810	5,756	4,428	7,748	5,960
55,000	46,200	10	3,586	2,759	6,040	4,812	9,438	7,887	13,312	10,164

The summary given in Table III points out that the irregularities produced by variation in the coefficient of

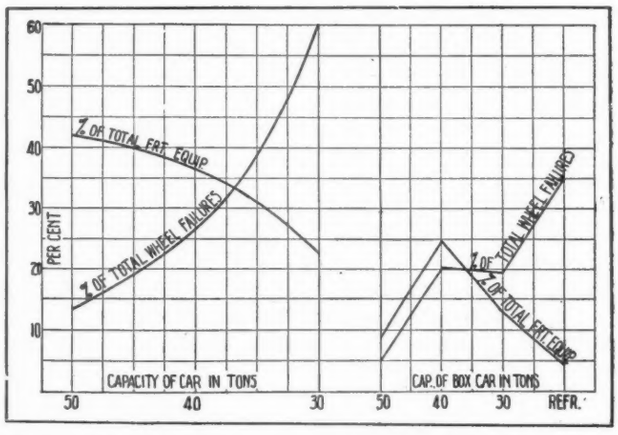


Fig. 4—Wheel failures reported by three railroads and the I. C. C. compared with the number of cars in service

brake shoe friction and by variations in the weight of cars is greatly increased by irregularities in piston travel. It is entirely possible to have intended to have a retarding force of 1,870 lb. per car but instead to have 13,300 lb. because of the variables. The possibility of such wide variation should be eliminated.

Departure from present standard

The fourth variable arises from cars in which the braking power is not calculated according to standard rules but is made from 10 per cent to 20 per cent above standard; also in this connection improper rod and lever connections may cause the braking power to be as low as 40 per cent or as high as 90 per cent. There is no provision for inspecting cars to find such errors.

The effect of irregularity in braking power

The effect of these irregularities is evident on the treads of car wheels. Where the braking power is very high, the heat energy which is developed by the brake shoe friction, sets up molecular agitation in the wheel even to the point of destroying the tread metal which is manifested in the form of brake burns, shell outs, etc., and when brakes "stick" on cars of this type the excessive concentration of heat energy may cause a cracked plate or even a broken wheel. The character of the damage is shown in Fig. 3 and represents a relatively large economic loss.

Chilled tread steel wheels

It has been shown that the refrigerator car has excessive braking power in comparison with other classes of cars. In reviewing cracked plate wheels the M. C. B. Wheel Committee determined the relation between

over weight of the car and the cracked plates which were then standard, as follows:

Tare weight 60,000 lb. capacity:	No. cars	Cracked plate	Ratio
Below 32,000 lb.	465,750	90	1 to 5,175 cars
Between 32,000 lb. and 42,000 lb.	346,210	241	1 to 1,430 cars
Above 42,000 lb.	43,040	497	1 to 87 cars

A recent review of failed wheels on one railway found the following type of cars as conspicuous trouble makers:

Kind of equipment	Structural failures	Number of cars in U. S.
C. P. X.	1	40
I. A. X.	1	92
J. B. B. X.	1	101
J. P. D. X.	1	226
D. S. D. X.	1	240
A. S. D. X.	1	269
P. M. Refr.	1	300
L. P. T. X.	6	2,400
S. L. R. X.	1	613
E. R. D. X.	3	3,164
W. C. I.	2	2,200
M. R. L. X.	2	2,416
U. T. L. X.	4	7,062
M. D. T.	3	10,000
P. T. X.	1	5,512
I. C. Refr.	1	5,689
S. R. L.	1	6,728
F. G. Ex.	1	17,849
F. F. Ex.	1	38,292
	33	103,193

In the reports of the Interstate Commerce Commission from June, 1925, to November, 1926, it is shown that derailments caused by over-heating under refrigerator cars occur with seven times the frequency that they do under the 30-ton box cars and with 42 times the frequency that they do under the 50-ton coal cars.

Combining the failures of wheels of one manufacturer, reported by the three foregoing railroads, and adding to them the failures reported by the Interstate Commerce Commission, and comparing the results with the number of cars in service, the following summary is obtained, shown graphically in Fig. 4.

Kind of car	Per cent of total cars		Per cent of wheel failures	
Refrigerator cars	4.3		35.0	
30-ton box cars	11.5		19.2	
Other 30-ton cars	3.4		4.8	
Total		19.2		59.0
40-ton box cars	22.6		18.5	
Other 40-ton cars	9.0		4.1	
Total 40-ton		31.6		22.6
50-ton box cars	7.9		4.1	
Other 50-ton cars	28.4		6.1	
Total 50-ton		36.3		10.2
70-ton cars		4.5		.7
Tank cars		7.0		7.5
Total all cars		98.6		100.0
Miscellaneous		1.4		

These results do not represent good engineering practice with respect to light capacity cars. If cars of heavy capacity can be operated without over-heating, there is no reason why cars of light capacity should not be free from the accident hazard of over-heating. The following facts have been thoroughly established:

First.—That under similar conditions of pressure and velocity the coefficient of brake shoe friction is greater for chilled tread wheels than for steel wheels.

Second.—That the rate of retardation for special cars of light capacity with heavy tare weight is decidedly greater than for regular equipment.

Third.—That records show the damage to wheels in service and consequent delays to traffic predominate where this concentration of heat energy is the greatest; namely, in relatively light capacity refrigerator cars.

Fourth.—That wheels broken by stuck brakes are not distributed by chance. It is therefore possible to predict with certainty that a certain number of failures will occur under certain equipment in a certain period of time.

Fifth.—Since failures do not follow the law of chance there is a direct personal responsibility for permitting this condition to continue as an economic loss and a hazard to traffic.

Remedy

It is obvious that any change that will cause each car to do its share of retardation is desirable and hence any move to smooth out irregularities is now, and always will be, fundamentally correct. The retarding force is the coefficient of brake shoe friction multiplied by the braking power of the car. Each of these factors has decided irregularities susceptible of correction. It is desired to have the product of the two factors constant. It therefore follows that any constant difference in the coefficient of brake shoe friction must be recognized and introduced into the formula for retardation. Also, the second factor, which is 60 per cent of the light weight of the car, varies through entirely too large a range to produce uniform results from car to car.

It is proposed to reduce this variable to 20 per cent, of the light weight of the car, thereby not only removing two-thirds of the initial irregularity, but at the same time it will remove two-thirds of the damaging results of undesired emergency action, or improper piston travel.

The foregoing analysis establishes a rule for calculating the braking power for all cars equipped with chilled tread wheels, as follows:

30-Ton cars, 14,000 lb. plus 20 per cent of the light weight of car.
40-Ton cars, 16,000 lb. plus 20 per cent of the light weight of car.
50-Ton cars, 18,000 lb. plus 20 per cent of the light weight of car.
70-Ton cars, 22,000 lb. plus 20 per cent of the light weight of car.

For all cars equipped with steel wheels the braking power is 25 per cent greater and the formula becomes:

30-Ton cars, 17,500 lb. plus 25 per cent of the light weight of car.
40-Ton cars, 20,000 lb. plus 25 per cent of the light weight of car.
50-Ton cars, 22,500 lb. plus 25 per cent of the light weight of car.
70-Ton cars, 27,500 lb. plus 25 per cent of the light weight of car.

These formulae do not affect cars of average tare weights. This being the case, there will be no material change in the braking power of 80 per cent of the ordinary freight equipment. There would be, however, a decided effect on the braking power of special cars of very heavy tare weight, which constitute five per cent

Table IV—The present braking power, the braking power suggested by the Car Construction Committee and the braking power recommended in this analysis

Capacity of car, Tons	Number of cars	Average weight lb.	Present A. R. A. braking power chilled and steel lb.	Proposed braking power: By Car Const. Comm. lb.	Proposed braking power: in this paper, Chilled lb.	Proposed braking power: in this paper, Steel lb.	Average change per car, in braking power: Chilled increase, lb.	Average change per car, in braking power: Steel increase, lb.
Regular Freight Equipment								
30....	446,200	33,900	20,340	20,470	20,470	20,780	440	5,635
40....	936,000	39,100	23,460	25,530	23,820	29,775	360	6,315
50....	1,063,900	42,100	25,260	29,530	26,420	33,025	1,160	7,765
70....	157,500	51,000	30,600	36,300	32,200	40,250	1,600	9,650
Total..	2,603,600	40,154	24,092	26,877	24,868	31,085	776	6,993
Special Freight Equipment								
Refrigerator cars								
							Decrease	Increase
30....	84,600	49,200	29,520	25,060	23,840	29,800	5,680	280
40....	62,300	55,500	33,300	30,250	27,100	33,875	6,200	575
Total..	146,900	51,872	31,123	27,261	25,223	31,528	5,900	405
Tank cars								
							Decrease	Increase
30....	19,700	35,200	21,120	20,860	21,040	26,300	80	5,180
40....	60,000	42,000	25,200	26,200	24,400	30,500	800	5,300
50....	68,900	47,900	28,740	31,270	27,580	34,475	2,530	5,735
Total..	148,600	43,834	26,300	27,843	25,429	31,786	871	5,486

of the total freight equipment and is responsible for the irregular distribution of heat energy on the treads of car wheels, producing undesirable shocks in the train and destruction to the metal in the treads of wheels developing abnormal stresses within the plates of wheels, all of which constitutes not only an accident hazard but also a large economic loss.

The following table shows the number of cars, the average weight, the present braking power; the braking power suggested by the Car Construction Committee a few years ago and the braking power recommended in this analysis.

Table IV shows that the average increase in braking power per car if applied to all cars, would be 776 lb. for 2,603,600 cars, whereas on the special freight equipment there would be a decrease of 5,900 lb. on 146,900 cars. The only change in making the correction is in the position of the fulcrum of the cylinder lever. The

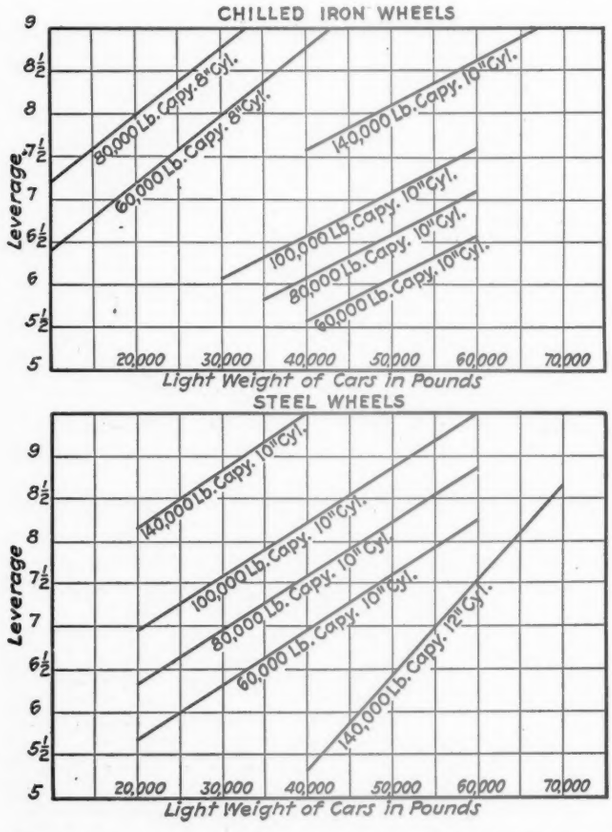


Fig. 5—Leverage for cars of various light weights and capacities

expense is practically negligible, and if permitted to do so the private car owners would, doubtless, immediately correct their own equipment on account of the saving that would accrue in wheel service. The change in general freight equipment should be gradual as new cars are built or as general repairs are required.

The leverage to be used for cars of any capacity of any weight, equipped with chilled tread or steel wheels is shown in the graphical chart, Fig. 5.

Foundation brake gear

In connection with foundation brake gear, there should be a standardization of freight car levers. If the A. R. A. recommendations for the use of truck levers having a ratio of 3½ to 1 became universal then the leverage of any car would be established by the location of the center hole in the cylinder lever. In considering the subject in general we may choose five ratios for truck levers between 3 and 4 inclusive, as follows:

Truck lever ratios

(r)	Ratio of force delivered to power received	3	3¼	3½	3¾	4
(4r)	Multiplication of power by four truck levers.....	12	13	14	15	16

It is evident that if the cylinder lever had equal arms, its ratio would become unity and the total brake leverage for four truck levers would be as shown above.

It is necessary to choose certain ratios for the cylinder lever which will reduce the excessive power of the truck levers to produce the final pressure desired. These ratios vary from 1.50 to 2.50. Table V is arranged to give several choices of truck and cylinder levers to produce the desired leverage.

In Table V, the braking power of the car is shown, the truck leverage, the leverage for four truck levers and the required cylinder lever ratio. The table is arranged for approximately 1,000 lb. increments in braking power, hence it will always be possible to find a corresponding leverage within less than 500 lb.

Assume a desired braking power of 27,000 lb., using the standard A. R. A. truck lever having a 3½ ratio drilled 7 in. and 17½, 1 in. Entering the table in the column "Braking power" at the quantity nearest 27,000

Braking power		Leverage Multiplication of cylin. power (N)	Reciprocal of Cylinder lever - Ratios (R)									
			2.42		2.25		2.08	1.93	1.80	1.70	1.60	
			2.5		2.33		2.16	2.00	1.86	1.75	1.65	1.55
8-in. cyl.	10-in. cyl.		Multiplication of power by four truck levers (4r)									
13,750	21,588	5¾		14		13		12				
14,375	22,569	5¾			14		13		12			
15,000	23,550	6		15		14		13		12		
15,625	24,531	6¼			15		14		13		12	
16,250	25,513	6½		16		15		14		13		12
16,875	26,494	6¾			16		15		14		13	
17,500	27,475	7				16		15		14		13
18,125	28,456	7¼					16		15		14	
18,750	29,438	7½						16		15		14
19,375	30,419	7¾							16		15	
20,000	31,400	8								16		15
20,625	32,381	8¼									16	
21,250	33,363	8½								16		15
21,875	34,344	8¾									16	
22,500	35,325	9										16
23,125	36,307	9¼										

Table V showing the relation of truck lever ratio and cylinder lever ratio to the braking power of the car

lb. we find the corresponding quantity in the leverage column to be 7. Following the horizontal line to 14, which represents the leverage for four truck levers and following the vertical column to the cylinder lever ratio, we find the cylinder ratio to be 2, which means that the power receiving end of the cylinder lever must be two times the delivering end. If the cylinder lever is standard (36 in.), the short lever arm becomes ⅓ of 36 in. or 12 in., and the long arm 24 in.; or if the cylinder lever is 30 in, long the short arm is 10 in. and the long arm 20 in. In any case, the cylinder lever ratio is four times the truck ratio divided by the desired leverage for the car.

This is sufficient to show the simplicity of the table which is made up for five different truck lever ratios. It is advisable, of course, to standardize on one truck lever ratio which would simplify the entire foundation brake gear. The cylinder lever can be standardized by ¼ in. variation in the length of each arm. There seems to be no difficulty in the way of a complete standardization of truck and cylinder levers.

The leverage and lever ratios should be stencilled on the side of the car. There is now no provision for inspecting the leverages of the cars and nothing to indicate the intended leverage or that the car was ever inspected in this regard. If all the cars were checked to

see how closely they approach the A. R. A. standard, a great many wide discrepancies would be found which not only cause property damage but constitute a menace to traffic.

The causes of accidents from over-heating and the equipment responsible for the result are such that the number of accidents in any period of time can be predicted with a considerable degree of precision. Accidents of this nature do not occur as a matter of chance. This being the case, an engineering problem is established and there is a definite responsibility somewhere for its solution. The adoption of revised rules for calculating the braking power of cars is of vital importance in minimizing damage to the treads of wheels, in decreasing the number of accidents and reducing the amount of property damage.

Further proceedings at Traveling Engineers' convention

Diesel electric possibilities outlined—Back pressure gages and limited cut-off fully discussed

AT the 35th annual convention of the Traveling Engineers' Association, held at the Hotel Sherman, Chicago, September 13 to 16 inclusive, as reported beginning on page 674 of the October *Railway Mechanical Engineer,* two of the features on the program given careful attention and fully discussed were the papers describing the results secured with Diesel electric equipment on the Canadian National and the committee report on the value of back pressure gages and limited cut-off.

Diesel-electrics on the C. N.

This paper, read by A. N. Boyd, road foreman of engines of the Canadian National, summarized the development of Diesel engine-driven equipment up to the present time and gave the experience of the Canadian National with this new form of motive power.

Regarding the Canadian National experience with nine Diesel electric cars equipped with Beardmore engines, Mr. Boyd said that "during 1926 these nine cars were in operation from Prince Edward Island to Alberta under three different regional general managers, necessitating the training of three separate maintenance organizations. Several of these cars have over 100,000 miles to their credit and none has been taken to the shops for general overhauling."

The following data was quoted on the average performance for the nine cars for 1926:

Motor car-miles	451,991
Trailer car-miles	238,676
1,000 ton-miles	35,872
Average daily miles	234
Days out of service account equipment	447
Days account transportation	291
Total scheduled days	2,667
Complete failures	43
Delays not included in preceding	109
Minutes delayed	3,629
Gals. fuel oil used	127,307
Average miles per gal. fuel	3.5
Gals. per 1,000 ton-miles	3.6
Gals. lubricating oil used	6,993
Average miles per gal. lubricating oil	64.4
Gals. lubricating oil per 1,000 ton-miles	.19
Operating efficiency	81 per cent
Revenue per motor car-mile	73.7 cents
Cost per 1,000 ton-mile	355.0 cents
Repairs per motor car-mile	6.5 cents
Fuel per motor car-mile	3.4 cents
Lubricants per motor car-mile	1.8 cents
Cost per motor car-mile	28.2 cents

Mr. Boyd continued as follows: "Inasmuch as the oil-electric locomotive has practically the same characteristics as the electric locomotive except that it has not the overload capacity, there is no reason why it should not operate almost continuously within the proper limits of its capacity. With the electrical equipment properly designed, lubrication and water cooling properly provided and with the fuel oil maintained reasonably uniform and thoroughly filtered, these engines should have a very high serviceability and be capable of running long distances without stop-over.

"We, on the Canadian National Railways, feel that this is very possible and are this summer extending our oil-electric cars by putting into service five more cars equipped with 300-hp. six-cylinder Beardmore engines and Westinghouse electrical equipments of arrangement suggested by our previous experience.

"In conclusion, the outlook for the use of the Diesel-electric motive power on steam railways is very hopeful and with all the engineering talent that is being expended on its development and application, our old and faithful friend, the steam locomotive, is going to feel the effects of the constantly increasing strength of this, its new competitor."

Discussion

In answer to a question, Mr. Boyd said that the Diesel engine equipment on the Canadian National has given satisfactory service under winter conditions and in some cases plowed through snowdrifts five feet deep which would have stalled steam locomotives. J. P. Stewart, Missouri Pacific, raised the question if Diesel-electric locomotives are not too slow for effective switching service. A member from the Lehigh Valley replied that a test Diesel-electric locomotive on his road proved entirely satisfactory in handling coal cars up a 3¼ per cent grade to a coal dock. He said that running switches were made with the locomotive, indicating that it was not slow.

Ralph Hammond, New York, New Haven & Hartford, said that gas-electric cars are proving entirely satisfactory, particularly for branch line service on the New Haven and are nearly fool proof in construction and operation. He indicated the need of a dead-man control to overcome objections on the ground that the car driver is isolated in the engine room in the front of the car and out of direct contact with the conductor or baggageman. A member from the Long Island said that experience with internal combustion motor-driven equipment on the Long Island indicates that big things are to be expected of it, particularly because of the possible greatly increased utilization as

well as fuel economy. Mark Purcell, Northern Pacific, asked if means are being provided for an adequate amount of air compressor capacity to furnish braking power for mechanically driven internal combustion equipment. Another member from the Canadian National stated that the Diesel electric equipment presents no difficulty from an operating standpoint since it is easy to break in enginemen to handle the cars properly.

Back pressure gages and limited cut-off

The report on the value of back pressure gages and limited cut-off was read by A. T. Pfeiffer, chairman of the committee handling this subject and road foreman of engines of the New York Central.

With reference to the value of back pressure gages, the committee reported the results of a questionnaire sent to the mechanical officers of several railroads with the following results:

"Replies were received from 20 railroads. Of this number two reported that they used such gages, but did not have sufficient information available to warrant a reply as to definite results; two reported that they did not have such a device in service. No complete information was received as to the total number of such devices in service. Of the 18 railroads reporting the use of back pressure gages, thirteen reported using the Ashcroft duplex type, one hand registering steam chest pressure and the other registering back pressure; two roads reported using the single type registering only the back pressure; and three roads reported using the Ashton double hand gage."

Of 14 roads reporting on the value of the back pressure gage, all agreed that it is of material assistance in determining incorrect nozzle sizes; 13 roads said that it helps in determining irregularities in valve setting; 12 roads said that it enables enginemen to detect and therefore prevent the formation of a vacuum in the cylinders while drifting, thus avoiding the scoring of cylinders; nine roads said that it helps in determining reverse gear creeping. Regarding the possibility of holding the back pressure to a predetermined amount regardless of operating conditions, three roads replied in the affirmative and three in the negative, without qualification; one road said that the matter is left to the judgment of the engineman, another that higher back pressure must be used on grades, and a third replied "yes" for freight service and "no" for passenger service.

The consensus of opinion was that the back pressure gage results in fuel and water economy, enables enginemen to work locomotives to better advantage, prevents abuse of locomotives and enables traveling engineers to demonstrate more clearly how to obtain the best results with locomotives.

A record of several operating factors secured over a division on a large eastern road with and without the use of a duplex cut-off control gage is shown below as included in the committee's report:

Item	Without gage being used	With gage being used
Type of service	Freight	Freight
Miles run	48	48
Actual tons in train	2,180	2,326
Temperature	60	55
Gross ton miles	104,640	111,648
Average speed	18.46 m.p.h.	22.86 m.p.h.
Total time on road	3 hr., 15 in.	2 hr., 19 min.
Running time	2 hr., 26 min.	2 hr., 06 min.
Coal consumed	9,600 Lb.	7,800 Lb.
Water consumed	63,700 Lb.	53,613 Lb.
Coal per 1,000 gross ton mile	91.7 Lb.	69.9 Lb.
Average boiler pressure	193.3 Lb.	197.0 Lb.
Average cut-off	41.6 per cent	31.0 per cent
Average throttle opening	68.0 per cent	88.0 per cent

This was not a dynamometer test and no accurate measure of train resistance was obtained. The theoretical train resistance over the ruling grade at 10 miles per hour was 27,032 lb. in the train without the use of the gage and 27,167 lb. in the train using the gage.

Regarding limited cut-off, the committee said:

"The use of limited cut-off entails no radical changes in the design of the locomotive. The principal change is the cutting of two slots known as auxiliary ports in the valve bushings. The use of limited cut-off results in economy of fuel and water with small sacrifice of starting effort and acceleration. In expansion ratio the limited cut-off locomotive approaches the compound engine, in uniformity of torque it is almost as good as the three cylinder engine and with this it combines the simplicity of the ordinary two cylinder engine; maintenance costs should be no greater.

"In nearly all cases of securing the advantages of a new mechanism we must sacrifice some of the features of the old, in the case of a limited cut-off engine the piston pressure must be increased which in turn means an increase in the weight of reciprocating parts. When the limited cut-off engine stops in such a position as to require all the steam for starting to pass through one of the auxiliary ports, time will be required to build up a steam chest pressure equal to boiler pressure; an occurrence of this kind takes place so seldom that it does not need to be given serious consideration.

"The design features which differ from the ordinary locomotive, but which cause very small differences in weight and cost, are in increased steam lap on the valve, a small auxiliary port cut through the valve bushing at each end of the steam chest, and a change in the ratio of the combination lever to compensate for the increased steam lap."

The committee reported that from actual tests on a large eastern road, a water saving of 11 per cent to 38 per cent was effected by the limited cut-off locomotive as compared with the conventional locomotive, depending on the load and speed. The committee drew the following general conclusion:

"From this it may be safely inferred that the limited cut-off locomotive should produce a coal and water saving in heavy slow freight service of about 20 per cent and in fast freight service from 10 per cent to 15 per cent. In passenger service we do not believe there is a place for the limited cut-off because of the negative effect due to increased weight of reciprocating parts of 10 per cent, or less."

Only a small amount of information was submitted in response to the committee's questionnaire sent to 20 railroads. Four roads, however, reported using limited cut-off locomotives with substantial economies. None of the roads reported the use of the limited cut-off in passenger service.

"Each of the roads reported a different percentage figure relative to maximum cut-off. Three roads each reported 60 per cent, 70 per cent and 80 per cent respectively, the fourth road apparently misunderstood our questionnaire and reported 25 per cent.

"All four roads reported the results obtained from the use of limited cut-off to be more satisfactory than those obtained from the use of a full stroke cut-off.

"One road reported no noticeable difference in starting trains, while three roads reported that the limited cut-off was at a slight disadvantage in starting, but handled the train more satisfactory than full stroke cut-off once the train was under way.

"All four roads reported that their experience with the limited cut-off reflected economies in fuel and water over locomotives not so equipped.

"Three roads reported no special difficulty in valve setting on a locomotive equipped with limited cut-off while

one road advised that it was slightly more difficult to set valves on an engine of this type.

"One road reported an increase in the weight of reciprocating parts due to use of limited cut-off. One road reported a decrease in such weights, and two roads advised that no changes in these weights were made. None of the roads reported any appreciable increase in wear and tear of the reciprocating parts due to the use of the limited cut-off."

Discussion

James Fahey (N. C. & St. L.) said that limited cut-off will do everything claimed for it by the committee, and in recent tests on the N. C. & St. L., in which the performance of a limited cut-off locomotive was compared with that of one having the valves set in the usual manner, the latter not only developed on the average three lb. more back pressure in the cylinder than the former, but had a substantially higher fuel and water consumption.

Fred Kerby (B. & O.) said that railroad men are sometimes apt to jump at conclusions and that more thorough tests of locomotive devices such as back pressure gages and limited cut-off should be made before advancing any recommendations. He urged the use of dynamometer cars and accurate measurements of fuel and water consumption before attempting to draw definite conclusions. In Mr. Kerby's opinion back pressure gages are of little value in locomotive operation because so many enginemen cannot or will not use them even after they are applied. Regarding limited cut-off, he said that there is little advantage in this valve arrangement over a period of time because the conventional locomotive operates at 90 per cent cut-off for short periods only, and during the balance of the time is operated with the reverse lever "hooked up" and the cut-off reduced to about 60 per cent. Mr. Kerby stated explicitly that he was not opposed to the application of new locomotive appliances but was decidedly opposed to "catch as catch can" conclusions regarding the economies which might be expected to follow their application to a locomotive.

A number of speakers following Mr. Kerby failed to support his conclusions regarding the value of back pressure gages and limited cut-off. C. I. Evans (M-K-T) said that the back pressure gage, even to the most experienced engineman, is highly beneficial and permits him to secure more economical locomotive operation. He mentioned the case of one man who told the superintendent of motive power that with a regular locomotive he would personally pay for the application of a back pressure gage rather than attempt to operate the locomotive without one.

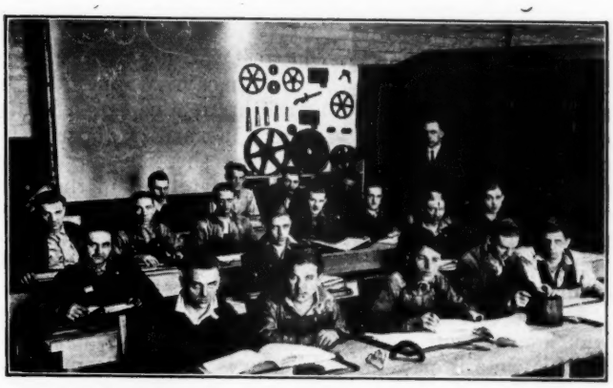
W. I. Quarles (A. C. L.) said that the use of back pressure gages will remove inequalities between enginemen in a pool, enabling the less experienced men to make good fuel records.

In closing the paper, Mr. Pfeiffer (N. Y. C.) said that in the limited cut-off tests referred to in the committee's report, water and coal measurements were sufficiently accurate to permit drawing reliable conclusions regarding economies effected by the use of limited cut-off.

METAL WORKING SMALL TOOLS AND MACHINERY.—Joseph T. Ryerson & Son, Inc., Sixteenth and Rockwell streets, Chicago, has issued a 272-page catalogue (No. 27) giving a brief description and general specifications for its metal working small tools and machinery. Prices and discounts for these tools are contained in Price Supplement No. 27A.

Burlington apprentice schools

VALUABLE work in the training of apprentices is now being done by the Chicago, Burlington & Quincy in co-operation with the local educational systems at two important shop points. The Burlington sponsors training schools at West Burlington, Iowa, and Havelock, Neb. The instruction in both schools is in the nature of extension work, the compensation of the instructors being provided in equal shares by the state, the local school board and the federal government.



Class scene at West Burlington Shops, Iowa

The school work at Havelock is under the direction of the University of Nebraska and at West Burlington is supervised by the director of industrial education and the apprentice instructor of the Burlington schools.

The school at West Burlington is typical. Here the teaching is done by the professor of industrial education at the Burlington high school. The 49 apprentice boys now employed, who represent all the regular shop

Class of shop apprentices at Havelock, Nebraska

trades, such as machinist, blacksmith, boilermaker, sheet metal worker, pattern maker, etc., are divided into three sections, each of which attends school four hours weekly during company time—7 a.m. to 9 a.m.

A class room is fitted up by the railroad in one of the shop buildings where the first group meets on Mondays and Thursdays, the second on Tuesdays and Fridays and the third on Wednesdays and Saturdays. The instruction is entirely on practical lines and in general consists of drawing, mathematics and shop practice. The drawing lessons stress free-hand sketching, not

with the idea of making draftsmen, but as a means of fixing in the boys' minds the principles of blueprint reading. For the beginning class a text book on "Shop Arithmetic" is used and enough elementary geometry is given to cover measurement of circles, etc., also cutting and grinding speeds, ratio and percentage. The more advanced pupils have work in strength of materials, gear ratios, gear trains, screw cutting, horsepower of belting and gears, horsepower of engines, and mensuration. Charts and models assist greatly in the work of instruction. In shop sketching, each locomotive part of casting used is selected in order to bring out some specific convention.

Each apprentice is given work for his own specific trade. For instance, while the machinist apprentice is sketching castings, the tinsmith apprentice is sketching elbows. roof flanges, etc.; the boilermaker apprentices and tinsmith apprentices are given sheet metal pattern drafting. This work must be accurate and in the case of boilermakers, all changes due to rolling, flanging, etc., are taken into consideration. For the blacksmith apprentices considerable time is given to figuring stock requirements, also heat treatment of steel.

Each apprentice receives his regular wages for the four hours spent weekly in attending these schools, so that his time is paid for while he is given free instruction. The only cost to the student is for books and sketch paper. The boys are encouraged to present any problems encountered in the course of their work. If of general interest they are taken up during the class period. If not, the instructor works them out with the individual at some other time.

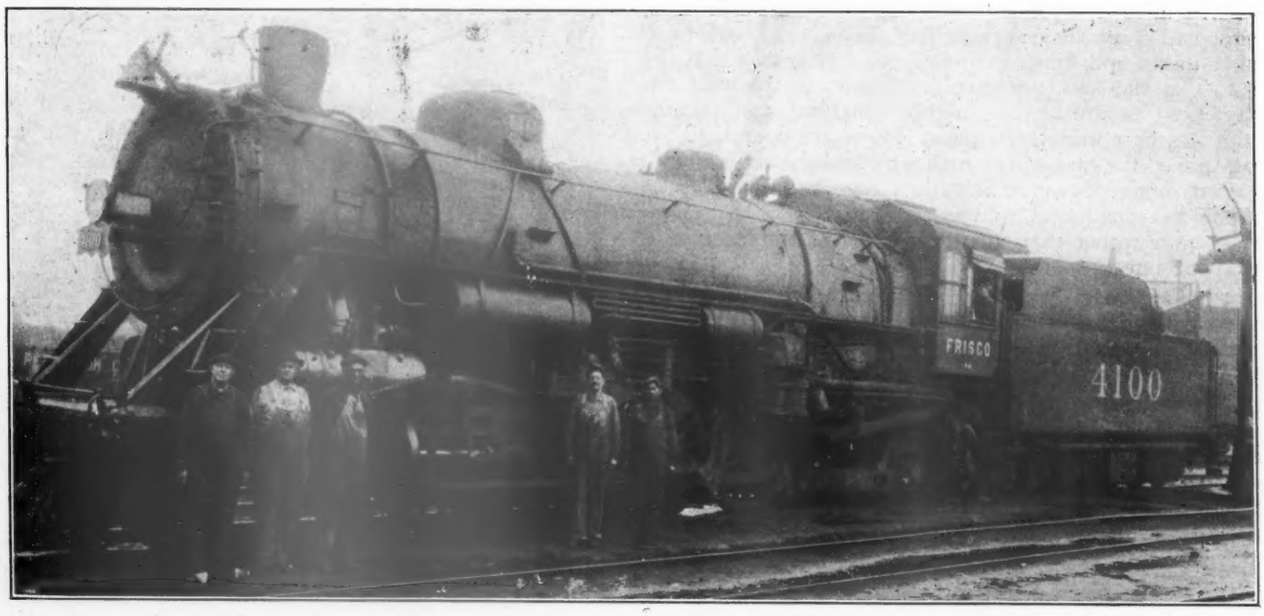
Monthly reports of the school room work are checked against reports of shop work, rating the ability of each apprentice according to his workmanship, accuracy, application, aptitude and skill.

The course of study is designed to continue through the apprenticeship term of four years, at the end of which each student is to receive an appropriate certificate of proficiency attained.

Although the schools were started only seven or eight months ago, the respective shop superintendents who have opportunity for daily observation are convinced that the plan has amply demonstrated its value. They are impressed with the interest shown by the boys and their apparent efforts to show progress in their work, both at school and in the shop. They note an improved morale among the apprentices and an inspiration to do their best, because of the interest which the management is taking in their training. If the school did nothing beyond this it would justify itself, but it promises even greater returns for both company and the apprentices through the making of better mechanics and the development of talents that might otherwise remain latent. As in all schools, the result depends upon the student. With enthusiastic instructors and the intelligent co-operation of foremen, the progress of an apprentice pupil is governed only by his own personal limitations.

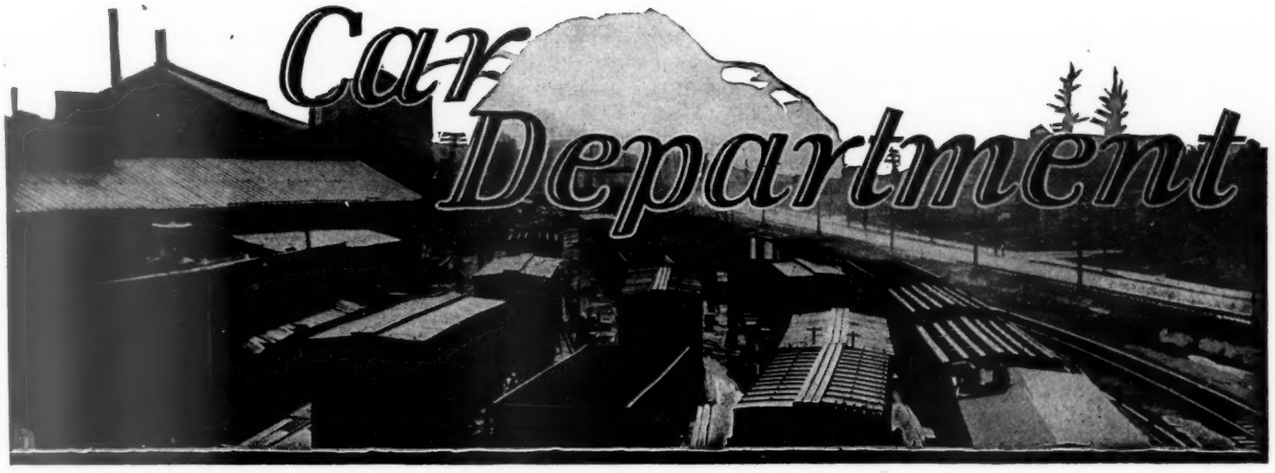
The Burlington is so well satisfied with its two schools that it is endeavoring to enlist the universities of other states where it has shops, in order that as many apprentices as possible may be given the same advantages.

In an address before a joint session of the National Safety Council and the National Committee for the Prevention of Blindness, Harry Guilbert, director of safety of the Pullman Company, advocated a mandatory ruling requiring every employee in an industrial shop to wear goggles while at work. Mr. Guilbert revealed that such a mandatory rule is enforced in all of the repair shops and yards of the Pullman Company, not only with respect to employees but just as stringently with officers of the company and visitors. This ruling, which requires that the eyes of every new workman be examined and specially fitted goggles provided, has resulted in a record of but one eye lost in a period of five years at the Pullman shops.



St. Louis-San Francisco locomotive No. 4100 at the completion of its 2,940-mile run

Left to Right—S. G. Manlove, road foreman; D. L. Forsythe, general road foreman; Frank Ellis, road foreman; A. H. Brake, engineman, and George W. Underwood, fireman. This locomotive made two round trips between Kansas City, Mo., and Birmingham, Ala., a total of 2,940 miles, with the same fire. It consumed 491,500 gal. of water and 281 tons of coal, handling 5,533,121 gross ton-miles at an average rate of 101.6 lb. of coal per 1,000 gross ton-miles.



Car officers' annual convention

Further proceedings at Chicago meeting include discussion of questions and preparations of billing repair cards

FOLLOWING the individual addresses and discussion of loading rules at the twenty-sixth annual convention of the Railway Car Department Officers' Association at Chicago, reported beginning on pages 593 and 673 of the September and October issues, respectively, of the *Railway Mechanical Engineer*, the members gave careful consideration to the report of the Committee on Preparation of Billing Repair Records, presented by M. P. Cole (B. & M.) The report of the Question Box Committee, read by J. J. Whelan (B. & O.) was also fully discussed, there being a total of 27 questions, of which only one, No. 12, was ruled out as not being clear. The questions and answers, as numbered by the committee, with No. 12 omitted, appear later in this article.

Preparations of billing repair cards

As instructed, your committee visited several railroads, car shops, transportation yards and general offices to investigate the practice of writing billing repair cards at the car, thus eliminating the separate original record of repairs and transcription on to billing repair cards.

We had rainy weather, and we took particular notice of the cards that had been written in the rain, and, after taking all features in consideration, your committee could see the possibility of its practicability and economy. It eliminated the separate original record and transcription from it on to the billing repair card and it tends to minimize wrong car numbers and other errors in copying.

The Arbitration Committee of the American Railway Association also appointed a committee to make a similar investigation, and they have recommended that this plan be made optional by amending Rules 7 and 8 of the interchange rules.

Your committee unanimously recommends this practice of preparing billing repair cards and record of repairs simultaneously at the car in preference to the old method.

The report was signed by Chairman M. P. Cole, Boston & Maine; L. M. Anderson, Northern Pacific; C. C. Hennessy, Cleveland, Cincinnati, Chicago & St. Louis, and C. C. Stone, Southern.

Discussion

Mr. Cole: The road which I represent put this system into effect January 1, this year, at some of our larger points and made a uniform method on the first day of April, at the same time we adopted the piece work system, at all points and we find no difficulty in using this system. Two years ago I entertained doubts before this system was put in effect and did not believe it was practical. Now I am thoroughly convinced that it is the only system which will give you a complete record of just what happens.

Secretary Sternberg: Does your report carry with it a form to be used in the train yards as well as on the repair track?

Mr. Cole: One form is to be used at all points where repairs are made, no exception. We are using this on our line 100 per cent.

M. E. Fitzgerald (C. & E. I.): Do you use two different forms; namely, piece work and billing?

Mr. Cole: We are using one form. On one end of this report is shown the amount of money that the piece worker earns; that is, on our card which we retain ourselves. We are using two colors in billing, a pink form covering all work done to home cars, and a white form for all work done to foreign cars. In the small yards where we do not have piece work we are using a form which we adopted previous to putting in the piece work which is the same, with the exception of the space on the right hand side that refers to work done by inspectors.

Mr. Fitzgerald: There are items required for the proper pricing of piece work that are not required for the pricing of an A.R.A. record. However, that goes into the billing office, too. I have had quite a time with my men to keep them from pricing piece work items. Another thing that we had difficulty with was the handwriting. That is important.

J. E. Mehan (C. M. & St. P.): Is the operation a success in a train yard? Our train yard supervisor

claims that in many instances we find men in the yard that are exceptionally good inspectors, but very poor writers. They have difficulty in having these original cards legible enough to go through with the bill. Then another objection: in very cold winter the inspector or repairman has mitts on. As he makes the repair he has to take mitts off and walk around with a loose leaf carbon. Then when he knows the card that he is writing has to go all the way to the owners he is liable to take too much time.

Mr. Cole: There is no trouble in the train yards under any condition. In the first place, this card is put in at the car inspector's building before he leaves his headquarters. It is said that under the old system he could abbreviate and the clerk in the office would know by the marks what he meant. I wonder how that would stand with the owners of the car should they make a check. You must satisfy the A.R.A. committee when they make their check and these abbreviations mean nothing to them. You had to write under the old system something intelligent enough to satisfy the car owners and the committee from the A.R.A. or your bill would be thrown out. The same thing applies to this system of billing; it must be plain enough so it will satisfy all concerned. We had some poor writers, but they have improved wonderfully under the new system. Nothing leaves our transportation yards and goes to a billing office that cannot be deciphered by a billing clerk.

Mr. Mehan: I wonder if the committee has made any check to observe whether this new system is a slower process so far as the inspection is concerned.

W. P. Elliott (Term. R. R. of St. L.): Did you get any data on the expense of the system?

Mr. Hennessy: The committee did gather data on the cost of this system and also the old, and this is the most economical. Economy all depends on the size of your railroad, the number of cars and the class of repairs. Now, in regard to operation in the train yards, it all depends on the tools you give your inspectors to work with. After you give them the backs that we use they will write their cards just as quickly. If you give him a loose card and carbon paper and if he has to put it in and out of the book he is going to lose time and slow up his work.

Mr. Elliott: I do not know just what figures you have, but I do know from personal observation that it is costing a great deal more money. I know from observation. I do not say if you gain anything on errors in transcribing. That depends on the foreman or supervisor.

W. R. Rogers (C. I. I., Youngstown, O.): I do not want to be considered an obstructionist, but you are doing a lot of guessing when you say you get 100 per cent in the transportation yards. We have hundreds of old, honest, reliable car inspectors that do not know how to write. If I was inspecting cars out at night in rainy weather and the superintendent after me and I had an air hose to put on and I had to stand at the car in the rain, I would forget to make a record.

F. E. Chesire (M. P.): We use this system and it is far better than the old system. Our inspectors do not write the best, but that is no objection against the new system. When we inaugurated the record system on the Missouri Pacific there was a clerical saving. It will work and does work where it is properly and carefully supervised. Mr. Mehan brought up the point of making checks and of making a duplicate record and copying it onto the other record. That has been done, but those men are not in the service any longer. The Missouri Pacific records are open to anyone. Our local supervisor is required to make a surprise check on every man at least once a week; that is the secret of our success with the record system.

Another point in favor is that billing repair cards are up-to-date, while, under the old system, cards were from two weeks to six months behind.

Mr. Elliott: I am going home with the impression that this system is more expensive.

Mr. Cole: The cost of putting this system into effect was $2,178 for folders. We have reduced about 18 clerks and saved for the first year approximately $7,000, and not on a very large road.

A. B. Schroeder (M. C.): I cannot tell you the exact figures, but we are saving over $10,000 per year, comparing this system with the old system. In connection with train yard operation, it is a matter of supervision. You can have two men on fast trains and while one is making repairs his partner can easily write up this card. I think that would solve Mr. Mehan's question.

J. J. Gainey (Southern): I really am surprised at the remarks our friend from St. Louis has made. We have not gone into the new system on the Southern, but I am in favor of it. Surely, if one railroad in this country can do it there isn't any good reason why the others cannot.

Secretary Sternberg: This committee has certainly gone into this question very thoroughly and has done excellent work, and I, therefore, move you that the report be accepted and the committee discharged with thanks.

(*The motion was seconded and carried.*)

Report of question box committee

Question No. 1

Q.—Is a charge of $1.35 proper for an angle cock when it has to be removed on account of a piece of train line broken off in it? Would this not be considered a defect as per the first paragraph of Rule 111?

A.—No.

J. E. Mehan (C. M. & St. P.): I am wondering just what the committee means. Do they mean we can charge for the angle cock?

Mr. Wagner: We have had several of those cases, and in each instance it has been found necessary to take the angle cock off the car and send to the shop in order to get the piece of pipe out, and that is the reason for the question being sent in.

Secretary Sternberg: We get them out with a cape chisel.

C. J. Nelson (C. I. I., Chicago): It seems to me that this is one of the questions and answers that is liable to cause confusion. With all respect to the Question Box Committee, I am afraid there is a loop hole there that will probably result in confliction and, in view of the importance of the question, I would suggest that it be omitted from the Question Box Committee's report.

Secretary Sternberg: I cannot look at that the way Mr. Nelson does. The question is whether or not the charge of $1.35 for an angle cock, when you have to take a piece of pipe out of it, is permissible. Is there anything in the rules that will allow you to charge for the angle cock. You could take the pipe out and you use it on some other car. I think the question is good and the answer correct.

T. J. O'Donnell (C. I. I., Buffalo, N. Y.): I move that this question and answer be approved by this body.

(*The motion was seconded and carried.*)

Question No. 2

Q.—Can a low coupler be raised by riveting a shim to the carrier iron? What difference does it make if the center line of draft is not paralleled to the center line of the sills? (See Rule 20, second paragraph.)

A.—If such work is performed, it should be considered as temporary repairs for which no bill can be rendered against the car owner.

(*The question and answer were approved.*)

Question No. 3

Q.—If a load is shifted through the end gate of a gondola car, can owner be charged for moving the load back onto the car to make repairs as per Rule 107, Item 421? If repairs could not be made with the load back on the car, then would repairing line be justified in charging 3.5 hours for removing and replacing the load?

A.—No. If the load had been placed in proper position, and if necessary to remove to complete repairs, labor charge for removing same is proper.

M. E. Fitzgerald (C. & E. I.): If the answer to this question is correct, I do not understand your answer. You say if the load has been placed in proper position.

L. W. Gunn (N. Y. C.): There are two angles to this. Would it be proper to make a charge to the delivering road and then turn around and make another R. & R. charge against the car owner?

Mr. Rogers: I think it is proper. I believe if you have re-adjusted the shifted load on cars, that is a handling lines responsibility. At the same time, if you have to apply center plate bolts, you can bill the car owner for R. & R. of the load.

W. J. Owen (C. I. I., Peoria, Ill.): I believe that the question and answer are proper. In case of a load that is shifted through the end gate you might be able to get it back with little expense and if you are unable to make repairs without R & R the load, a charge is proper. I move you that it be accepted.

(*The motion was seconded and carried.*)

Question No. 4

Q.—If a car is weighed 4-20-25 and a repair card of an intermediate line, dated 11-1-26, is offered as evidence that old stencilling was not obliterated, is owner justified in demanding cancellation of charge in view of the fact that over eighteen months have elapsed and car was again due for re-weighing?

A.—No.

(*The question and answer were approved.*)

Question No. 5

Q.—Rule 20, fourth paragraph, states that couplers on empty cars should be adjusted to 34½ in., or as near as practicable thereto. What minimum height is considered "as near as practicable thereto?"

A.—No specific minimum height can be considered as the rule states the coupler heights must be adjusted as near as practicable.

(*The question and answer were approved.*)

Question No. 6

Q.—If a car is received with Westinghouse friction draft gear not missing complete but what is on the car is broken, and a wooden block is applied in place of the friction draft gear, should we card the car at all or who is responsible for the draft gear?

A.—Inasmuch as the draft gear was not missing complete, a defect card is not in order.

Mr. Mehan: On just what basis did the committee decide this answer, when the question states that the friction draft gear was broken.

Mr. Whelan: The committee considers that interpretation of Rule 95 covers.

Mr. Fitzgerald: I believe it is a fact that the road removing a friction draft gear and substituting a block instead should apply a defect card to the car at that time.

E. S. Swift (Wabash): The gear was not missing complete in this case. If the gear is missing complete and you put in a wooden block, it is a delivering line responsibility. But, in this case, the draft gear was broken and not missing, and a wooden block was placed in the gear, therefore not being a cardable defect.

Mr. Mehan: When a car comes to you with a friction draft gear missing complete, it is a delivering line defect, but in the event the draft gear is not entirely missing and temporarily fixed with a wooden block, do we understand that you contend it to be a delivering line defect?

Mr. Whelan: No, it is owner's defect, but when you put the wooden block in there you are making temporary repairs.

Mr. Nelson: In answer to Mr. Mehan's question, no defect card is due unless the draft gear is missing completely.

Mr. Fitzgerald: This question is going to be broadcasted all over the country and, as Mr. Mehan has put this matter before us, it is not clear that the party repairing this car removed the draft gear and substituted a wood block. If that is a fact, the question and answer is right, but I would suggest that the answer read that if the broken parts of the gear were removed complete defect card should be issued, which would clarify it.

The Chair: Mr. Mehan, will you state your motion?

Mr. Mehan: The motion is this: "Inasmuch as the draft gear was not missing complete, a defect card is not in order."

(*The motion was carried and the committee's answer approved.*)

Question No. 7

Q.—When the handle portion (only) of coupler release lever is R.R. or R. what item in Rule 107 applies?

A.—Item 254 applies.

(*The question and answer were approved.*)

Question No. 8

Q.—Attached blue print shows top sill on a side-dump gondola car. Do you consider this as a side plank and would you charge labor as per Item 295, Rule 107; if it is not a side plank, does Item 433, Rule 107 cover the labor charge? (This item is secured to the car with bolts over 6-in. in length.)

A.—Item 433 applies.

(*The question and answer were approved.*)

Question No. 9

Q.—If a 5-in. by 7-in. coupler is removed from a car stencilled "Type D coupler," should credit be allowed for scrap or for second hand former standard coupler removed? Are 5-in. by 5-in. and 5-in. by 7-in. couplers still regarded as A.R.A. standard material?

A.—Rule 17, Paragraph (d) is applicable.

Mr. Mehan: Is that answer sufficient? The person who proposed this evidently had Rule 17 in front of him and there seems to be a little confusion as to how the rule does apply. In a little more detail we could tell him just what he should do instead of quoting the rule.

Mr. Whelan: We consider in this case that the rule was clear enough that when you remove the coupler you must allow for second hand coupler.

(*The question and answer were approved.*)

Question No. 10

Q.—If an end gate or side dump door is missing, with evidence that it had been removed to facilitate unloading, is it a cardable defect in interchange? (See Arbitration Case 1395.) If it is not cardable, then how is the owner to get protection?

A.—No.

Mr. Mehan: Your question states the man had evi-

dence. If he had such evidence, I do not think your answer is right.

Mr. Rogers: I am in full accord with Mr. Mehan.

Mr. Mehan: They evidently base their decision on No. 1395. You will find the decision is based on the fact that there was no evidence to show removal to facilitate loading. There is evidence in the question asked and that is an entirely different thing.

Mr. Nelson: I believe the position taken by Mr. Mehan is proper and I would offer for consideration of the members that the answer read like this, "Unless it is known where, when and by whom the parts were removed to facilitate loading or unloading."

Mr. Mehan: I will second Mr. Nelson's motion.

(*This motion was seconded and carried.*)

Question No. 11

Q.—If a 5-in. by 7-in. coupler is applied in place of a 5-in. by 5-in. coupler, should our defect card cover "Labor only," or should it authorize the other to charge material, too? (See Rule 17-c, third Paragraph.)

A.—Defect card to be issued for labor and material. See Paragraph (d).

E. S. Swift: Whether the common 5-in. by 7-in. coupler comes under the same rule as the 5-in. by 5-in., you should adjust charge and issue defect card for labor only.

Mr. Mehan: I move that the answer read:

If proper side clearance did not already exist to accommodate the 5-in. by 5-in. coupler and defect card should be issued for labor and material. See last paragraph Rule 17, section (c), which reads as follows: "Existing cars equipped with 5-in by 5-in. shank couplers shall have the existing type of couplers maintained in repairs. Where changes are made in the design of draft arrangement, provision should be made for the application of either the 5-in. by 7-in. or 6-in. by 8-in. shank A. R. A. standard type D coupler.

(*The motion was seconded and carried.*)

Question No. 13

Q.—If a tank car with two steel center sills only is delivered to another line with both sills bent, are we responsible, whether we know that the car was damaged on our line or not? If our inspector at the receiving station failed to notice the damaged sills, that does not establish the fact that we damaged them.

A.—*Yes.*

Mr. Mehan: You must offer an explanation to the receiving line as to how they became damaged. If you cannot explain that, then a defect card is in order.

Mr. Nelson: Under Rule 44, unless the delivering line is unable to establish the fact that the damage was not due to unfair usage or explain the circumstances under which the damage occurred, I think the arbitration decisions will substantiate this statement.

Mr. Owen: Why cannot we furnish the owner a statement showing that damage occurred in ordinary handling, which should be sufficient to eliminate any objection of rough handling or unfair usage of the car.

Mr. Mehan: I move that the answer read thus:

The handling line must furnish the defect card because when the car passed in interchange there was no record of the damage existing at that time.

(*This motion was seconded and carried.*)

Question No. 14

Q.—Can material charge be made for a triple valve union gasket when applied in connection with Item 29, Rule 111?

A.—No

(*The question and answer were approved.*)

Question No. 15

Q.—Road A makes wrong repairs and applies defect card, per Rule 87. Road B ten days later, perpetuates these wrong repairs, because they failed in fair usage, and applies defect card. Does this invalidate road A's defect card? Who is responsible for repairs made by road B?

A.—The road perpetuating wrong repairs is responsible. See Arbitration Decision 1346 which is parallel.

(*The question and answer were approved.*)

Question No. 16

Q.—Car is equipped with KDE brake equipment and is so stencilled. K-2L triple valve is removed account of being broken in fair usage and A.R.A. standard K-2 triple valve is applied, and an ordinary ten-inch reservoir. A four-compartment reservoir is removed in O.K. condition. Should scrap credit be allowed for reservoir removed? Does this constitute wrong repairs? If so, what rule applies?

A.—Allow scrap credit for non-standard reservoir removed. It is not wrong repairs to apply standard triple valve in lieu of non-standard.

(*The question and answer were approved.*)

Question No. 17

Q.—A refrigerator car is weighed on account of being materially changed, due to repairs (car is not out of date) but is found to have a variation of 400 lb. between new and old weights. Car owner is responsible for repairs. Is owner also responsible for weighing the car?

A.—Yes. See Section 8, paragraph (f), also paragraph (d) of Rule 30.

(*The question and answer were approved.*)

Question No. 18

Q.—Shop X on road A makes wrong repairs and applies defect card per Rule 87. Shop Y on same road subsequently corrects these wrong repairs by ordering material from owners 60 days later. Who is responsible for freight charges for material ordered from owners?

A.—Repairing line is responsible for freight charges.

Mr. Whelan: The committee had some discussion as to whether it was owner's or delivering line defects.

Mr. Nelson: I would suggest that the answer read: "If repairs were made on account of delivering company defects, repairing line is responsible for the freight charges."

Mr. Owens: I think that the line responsible for the material is responsible for the freight charges. If the owner is responsible for the material he is also responsible for the freight charges in shipping such material.

(*The question and answer, as worded by the committee, were approved.*)

Question No. 19

Q.—Defect card is issued for labor and material. Card should have been marked "Labor only." Car owner bills carding road as per defect card. Carding road takes exceptions to bill, stating that their billing repair card shows that an error was made when card was applied. The charge should not exceed the price for the labor of correcting wrong repairs. Is the contention of the carding road correct?

A.—No. Arbitration decisions 1398 and 1451 parallel.

(*The question and answer were approved.*)

Question No. 20

Q.—Rule 17: Is the substitution of a wrought iron A.R.A. standard yoke in place of cast steel yoke wrong repairs?

A.—Yes.

(*The question and answer were approved.*)

Question No. 21

Q.—Rule 30: Should joint evidence that load limit was not stencilled on car at time of re-weighing on a foreign line be considered? Should not the part of this rule requiring load limit markings on all cars become effective before joint evidence is in order?

A.—Joint evidence cannot be considered. Under the present rules, car owner is the only one to apply the original load limit marking.

Mr. Cheadle: The answer says that joint evidence

cannot be considered. The car has already been weighed and marked properly; the second weight someone fails to re-stencil; would a joint evidence be proper in that case?

Mr. Whelan: This question is correct. I would not change stencil for load limit.

Mr. Mehan: I think the answer should read:

Under the present rule, car owners are the only ones to apply the original load limit marking.

(*The answer was changed to agree with Mr. Mehan's suggestion.*)

Question No. 22

Q.—Rule 68: Is the mate to a slid flat wheel automatically scrapped so far as credit in A.R.A. billing is concerned, regardless of length of flat spot or spots?

A.—Yes.

(*The question and answer were approved.*)

Question No. 23

Q.—On page 175 of the A.R.A. Rules is shown a table of draft springs. Are all springs shown to be billed as per item 187 of Rule 101, which is .045 per pound, less .005 per pound credit, or, are some of the springs shown billable at store department cost plus 15 per cent?

A.—Yes.

(*The question and answer were approved.*)

Question No. 24

Q.—Road A delivers one of its passenger cars, which is equipped with cast iron wheels, to Road B. One pair of wheels are slid flat 1¼-in., which condemns it for passenger service. Road B request defect card for the flat wheels, removing some. When wheels are delivered to wheel shop the wheel inspector, whose inspection is final, O.K.'s wheels for freight service. Can Road B bill Road A for more than the labor of changing the wheels?

A.—Yes.

(*The question and answer were approved.*)

Question No. 25

Q.—Who is responsible for damage to running board saddles on house cars when damaged in connection with damage to running board due to having been struck, on the end, there being no other damage to the car?

A.—The owners are responsible.

(*The question and answer were approved.*)

Question No. 26

Q.—Should tank car running board supports, which are secured to center sills with rivets, *be classed as safety appliance details* as enumerated in Interpretation 4 of Rule 33, which makes owners responsible in cases where bolts are substituted for rivets?

A.—Yes.

(*The question and answer were approved.*)

Question No. 27

Q.—Does this interpretation apply when such repairs are made on repair tracks?

A.—Yes.

(*The question and answer were approved.*)

The report was signed by G. K. Oliver, chairman; M. P. Williams, N. P.; W. H. Hall, C. & O.; and J. J. Whelan, B. & O.

Safeguards for spraying finishes

Attendant fire hazard requires segregating the process from other shop operations

THE increased use by the railroads of various enamels, lacquers or finishes having a nitrocellulose content, properly termed "pyroxylin finishes," and in fact the application by spraying of any type of finish whatever, has brought new conditions of work, especially in the car department, which have aroused considerable apprehension in insurance circles and among many mechanical department officers. Considerable has been said relative to the effect of spray painting upon the health of employees, and more recently attention has been brought to the attendant fire hazards. Many hasty conclusions have been made based on deductions rather than investigation of facts, and apparently no distinction has been made between lead paints, which are usually slow drying and the newer quick-drying finishes or between the different conditions of application of these two classes of coating materials.

Relative to the health situation, a recent canvass made by the National Safety Council of the health records of six states produced only a few cases where occupational diseases are claimed to have resulted from spray painting with quick-drying pyroxylin finishes, and only one death. At the present time investigations by competent bodies are under way and, it is hoped, will yield more reliable information than is now available on this subject.

As regards fire hazards, careful investigations and tests have been made by the Railway Fire Protection Association, the National Fire Protection Association, the National Board of Fire Underwriters, and a number of manufacturers of lacquer finishes. A large part of the material contained in this article has been obtained from publications and pamphlets of these associations, as the result of their study and experience.

Quick-drying pyroxylin compounds (lacquers) have been in general use for years, and their use heretofore has never provoked apprehension either from the fire or health standpoint. It is recognized, however, that the application of paints, varnishes, pyroxylin and other inflammable finishes made by spraying is a process which induces severe hazards. Extensive fires, heavy damage and considerable loss of life will result in shops where the dangers are not recognized and suitable precautions are not observed. These hazards are generally well understood at railroad car shops, although not always fully safeguarded.

The pyroxylin lacquers now coming into use for finishing railway equipment consist of a solution of nitrated cotton dissolved in such inflammable solvents as alcohol, acetone, amyl acetate, ethyl acetate or benzol, to which have been added gums, resins, pigments, flexible oils, etc. Flash points of the solvents used range from 10 deg. F. to over 50 deg. F., the flash point of the finishing material itself being, in most cases, considerably lower than ordinary room temperature. Because of this, acute flash fire or explosion possibilities may be introduced where large quantities are being sprayed unless

adequate ventilation is provided. The lacquer dust or residue which may be formed in the air during the spraying process is very flammable and increases the fire hazard if allowed to accumulate. The first consideration should be given to separating the spraying process from all other such operations. A separate building should be provided or a finish room cut off by fire stops from the balance of the shop.

In general, it may be said that precautions which adequately meet the requirements where oil paints and varnishes are being applied by spraying and where paint and varnish removers are being used, are not essentially different than those necessary where pyroxylin lacquers are being applied by spraying.

Regulations of the National Fire Protection Association

There has been in existence for some years a set of rules prepared by the National Fire Protection Association and promulgated by the National Board of Fire Underwriters, covering the hazards of spraying. The rules were prepared after a very careful study of the materials and the modes of their use. There has yet to be found the case of any spraying process fire of any importance in which there was not a violation of these special rules or a violation of the elementary principles of fire protection, which led to the event or to its serious consequences. In fact, almost every case reviewed, whether large or small, revealed violations of these rules. While changes in manufacturing systems and materials may lead to elaboration of the rules, the principles of the existing rules will still apply.

The following principles of fire protection may be regarded as elementary, and as forcefully applying to plants where spraying is done. The so-called "spray booth rules" are merely the specialized application of these principles:

1—If an operation is dangerous it should be so isolated or cut-off by partitions, walls or open spaces that fire arising from it will not be communicated to other areas and that water used in its extinguishment will not do damage in adjacent or lower areas.

2—If an area presents a hazard of rapid development of widespread fire due to the character of the material present, so that the fire extinguishing facilities will be overtaxed, that area should be so subdivided that the available extinguishing facilities will be effective.

3—If the rate of burning of the materials involved is greater than that for which ordinary fire appliances are designed or the generation of heat is more rapid than can be overcome by the application of water or other extinguishing agent in usual amounts, the speed of action and the quantity of the extinguishing medium applied should be adequately increased.

4—If a material is so sensitive to ignition that exposure to minor sources of heat will ignite it, all sources of heat which will cause ignition must be eliminated from the area in which the material is present.

5—If a material is dangerous with respect to spontaneous heating special care must be given to cleanliness. General cleanliness is a fundamental precaution.

6—If an area is dangerous, all material not immediately in use or essential to the occupancy of that area should be removed from it.

Finishing shops for railroad rolling stock

The following suggestions for safeguarding against finishing process fire hazards were adopted by the Railway Fire Protection Association at New Orleans, La., October 12, 1926, on the recommendation of its Special Committee on Pyroxylin Lacquers and Finishes.*

New buildings—The employment of fire-resistive construction and provision for adequate subdivision are perhaps more important in a car-finishing shop where oil paints and varnishes and pyroxylin finishes are sprayed than in any other building, due to the character of the operation, particularly if provision is not made for paint and varnish removal in a separate detached building. In the erection of new layouts nothing but fire-resistive construction should be considered for this occupancy.

Existing buildings—In the safeguarding of existing plants, the first move should be to effect distinct fire subdivisions. The degree, of course, with which this can be accomplished is governed by the design of the building which frequently doe not lend itself to the installation of fire walls and stops without some inconvenience to operating requirements.

Unless the finishing shop is cut off from the remainder of the building by standard fire walls, it should be segregated by means of a fire-resistive partition or wall which will afford at least one hour's protection as described in section entitled "Finishing Shop."

Storage of main supplies of finishing materials—Main supplies of finishing materials should be stored in an outside storage house preferably of non-combustible construction, or in a properly cut off and protected inside storage room.

An inside storage room should be avoided; where one is necessary it should be located at or above grade and, where practicable, in a corner of the building. Special care should be taken to locate it away from sections having combustible and valuable contents. If adjacent thereto, it should be cut off from the remainder of the building by walls or partitions, continuous from floor to ceiling, securely anchored and of one of the following types of construction: Reinforced concrete; brick; expanded metal lath encased in solid cement plaster not less than 2½ in. thick; gypsum or cement plaster at least 1¼ in. thick on metal lath on each side of a stud partition; tile, gypsum, or concrete block (cement plaster on each side with thickness of ¼ in.).

In lieu of the foregoing, any type of partition construction may be used which will afford one hour's protection as determined by the specifications for standard fire tests of non-bearing partitions.

Ceiling, or roof, unless of fire-resistive construction, should be protected with double treatment of ¾ in. cement or gypsum plaster on metal lath, separated by 2 in. air space, or its equivalent.

Floors unless equal to two-ply matched boards and free from cracks and other openings should be protected with 2 in. of concrete. If situated over damageable materials or products, floors should be water-proofed, and provision made for drainage to a safe place.

All wall or partition openings should be protected by approved fire doors of a type suitable for use in openings in corridor and room partitions, and installed in accordance with the requirements of Class C of the National Fire Protection Association's Regulations governing the "Protection of openings in walls and partitions against fire."

Good ventilation is essential in all storage houses and rooms. Ducts should be of substantial metal construction extending above roof of building and terminating in an efficient suction-creating device and having screened openings at floor level.

Artificial lighting should be restricted to electricity, employing vapor-proof globes and with installation in accordance with the requirements of the National Electrical Code for extra hazardous locations.

For heating purposes only indirect systems such as steam, hot water or hot air should be employed.

Shelving and supports should be of metal or other non-combustible material.

Room should be equipped throughout with automatic sprinklers.

Local supplies and mixing rooms—All mixing and thinning in quantity, except a small amount which may be necessary in finishing shop, should be conducted in a room separated from the remainder of the building.

Respecting such features as location of mixing room, wall and partition construction, protection of openings therein, ceiling construction, floor drainage, ventilation, lighting, heating and automatic sprinkler protection, the requirements set forth for inside storage rooms under "Storage of main supplies of finishing materials" should be complied with.

The mixing room should not be used for storage purposes. The quantities of finishes and thinner permitted therein should be dictated by the demands of normal operations. Finishes should be kept in the mixing room until needed, and every effort made to reduce to a minimum the quantity present in finishing shop.

All mixers, filters, pumps, motors, shafting, etc., should be electrically grounded in an effective manner to prevent accumulations of static electricity. Belts should also be provided with grounded combs or treated frequently with a fifty-fifty mixture of glycerine and water in order to prevent the accumulation of static electricity.

Finishing (spray) shop—Partitions unless of standard fire-resistive construction may be of the following construction and should be continuous from floor to ceiling or roof and be securely anchored: Expanded metal lath encased in solid cement plaster not less than 2½ in. thick; gypsum or cement plaster at least 1¼ in. thick on metal lath on each side of a stud partition; tile,

* See Handbook of the Railway Fire Protection Association, page 296-A.

gypsum, or concrete block (cement plaster on each side with thickness of ¼ in.).

In lieu of the foregoing, any type of partition construction may be used which will afford one hour's protection as determined by the specifications for standard fire tests of non-bearing partitions. Ceiling, or roof, unless of fire-resistive construction, should be protected with double treatment of ¾ in. cement or gypsum plaster on metal lath, separated by 2 in. air space, or its equivalent. Walls in frame buildings should be protected with 1¼ in. of cement or gypsum plaster on metal lath or its equivalent. Floors unless equal to two-ply matched boards and free from cracks and other openings should be protected with 2 in. of concrete.

All wall openings should be protected with fire doors of approved automatic or self-closing type, suitable for use on openings in corridors or room partitions and conforming as to installation with the Class C requirements of the National Fire Protection Association's regulations for the "Protection of openings in walls and partitions against fire."

Ventilating system—The importance of adequate ventilation wherever flammable finishes are applied by the spraying process cannot be over-emphasized. It is characteristic of quick-drying finishes, particularly, that the solvents evaporate very rapidly, thus giving momentarily a higher concentration of solvent vapor in the air than is the case with slower-drying finishes.

The vapors from flammable finishes are heavier than air so that open windows or skylights will not provide adequate ventilation.

Mechanical ventilating systems should be installed. They should be capable of effecting a complete change of air at least every ten minutes, and preferably every three minutes, according to the amount of materials used and cubic capacity of finishing shop.

First aid appliances, similar to those called for in paint and varnish rooms, should be provided in suitable quantity to fight fires in the lacquers and solvents. Automatic sprinkler protection should be provided to cover this work wherever possible.

Finishing (spraying) the interior of cars—Sufficient ventilation should be provided to carry vapors outside of cars where they can be removed by the finishing shop ventilating system.

Electric equipment—All electric apparatus shall be in strict accordance with the National Electrical Code governing such apparatus in hazardous places. Only incandescent or mercury vapor lamps shall be used for lighting. Lamps shall be protected by vapor-proof globes. No spark-producing cutout, switches, detachable plugs, or unprotected portable lamps shall be used within these occupancies.

Spraying—General rules—Containers supplying spray nozzles shall be of closed type or provided with tight-fitting metal covers kept in place. Tanks not resting on the floor shall be supported on metal brackets or suspended by wire cables. Gravity tanks shall not exceed 10 gal.

If an original container is used, it should be mounted on strong brackets which will hold it securely in place while in use.

Air pressure, if used on original containers, shall not exceed 10 lb.

Empty drums and other empty containers shall be promptly removed from spray room.

Piping shall be strongly erected and rigidly supported. Valves shall be provided in pipes where flexible hose is taken off and these shall be kept closed when hose is not in use.

Open flames, sparking devices, etc., prohibited—The use of open flames or spark-producing devices in storage and mixing rooms and finishing rooms or in close proximity to same should be prohibited. For heating purposes only indirect systems such as steam, hot water or hot air should be employed.

Housekeeping—Scrupulous cleanliness should be maintained at all times in any occupancy where this process is used. Good housekeeping is absolutely essential, if fires are to be prevented.

Absolutely no smoking should be permitted in shop where finishing materials are applied by spraying, or in the room where the lacquer, paints, varnishes, thinner, etc., are mixed or stored. Conspicuous signs should be posted.

Floors of finishing rooms should be thoroughly cleaned at least once a day and fans, ducts, side walls and ceilings kept as clean as practicable at all times.

Fibre brooms or brass or bronze implements should be used for this purpose in order to avoid the creation of sparks.

Where practicable surfaces cleaned should be sprayed or otherwise wet down with water before cleaning.

Approved waste cans should be provided for all rags and waste.

Sweepings and deposits should be disposed of immediately.

It is also important that finishing rooms be kept free from all unnecessary combustible material.

Removing hollow piston rods from cylinder pistons

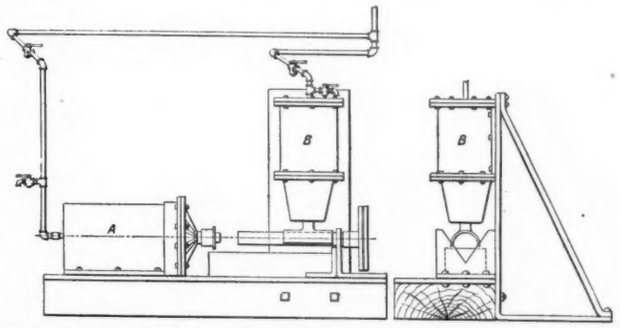
By H. G. Myrick

Air brake foreman, Chicago & Alton, Bloomington, Ill.

FOR the air brake man who is renewing any considerable number of brake cylinder piston rods on freight equipment, the machine shown in the illustration will be of benefit, not alone in the saving of time consumed in knocking the rods off by hand, but also in the saving of material.

The machine is made of old material that can be found around any railroad shop. The main cylinder *A* is from an old hose mounting machine, while the cylinder *B* is an old 8-in. by 7-in. brake cylinder, both having solid piston rods. A piece of 3-in. pipe is cut in two lengthwise and welded on the end of the push rod of cylinder *B* to hold the piston rod while the head is being pushed off.

A piece of 2-in. pipe 21 in. long is put inside of the hollow rod to be removed. Force is applied by cylinder

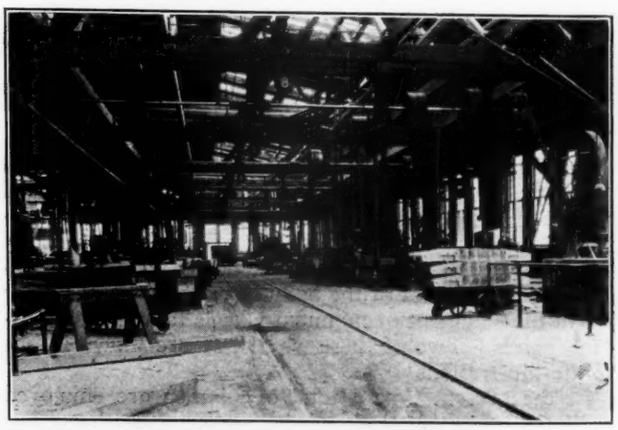


A machine for removing hollow piston rods from freight brake cylinder pistons

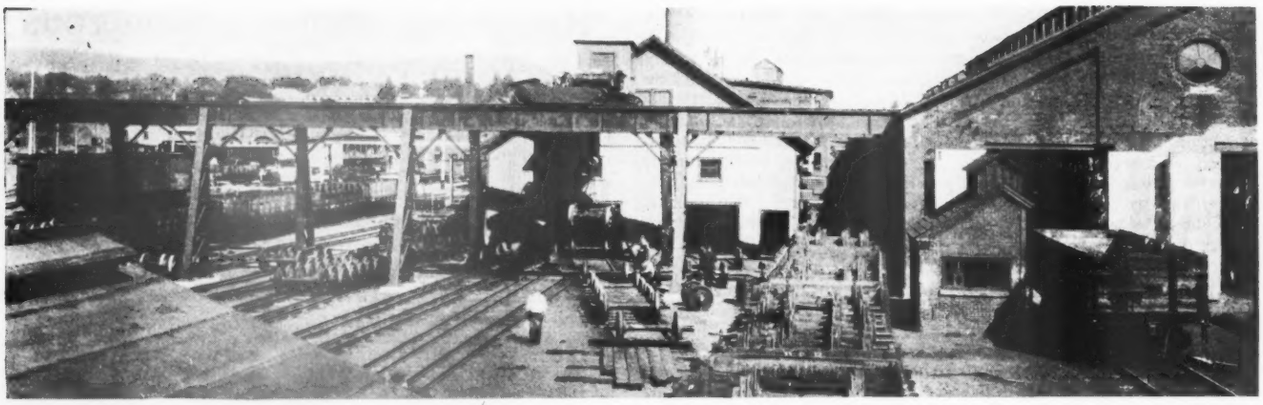
B to hold the piston rod in place while the full shop pressure from cylinder *A* is pushing the head off.

The four rivets holding the piston rod to the head are removed before putting the piston in the machine. Occasionally a piston will be found that is hard to remove, but it can easily be loosened by tapping with a hammer around the collar of the head.

All parts of the machine are bolted to a 4-in. oak board base. The cylinder *B* should be bolted to its bracket and then fastened to the wall.



This large well equipped wood mill is located at the Readville, Mass., shops of the New Haven



Delaware & Hudson wheel repair shop, Oneonta, N. Y.

D. & H. centralizes its wheel repairs

Reorganization of car repair facilities now being effected—Wheel shop at Oneonta handling the work for the entire system

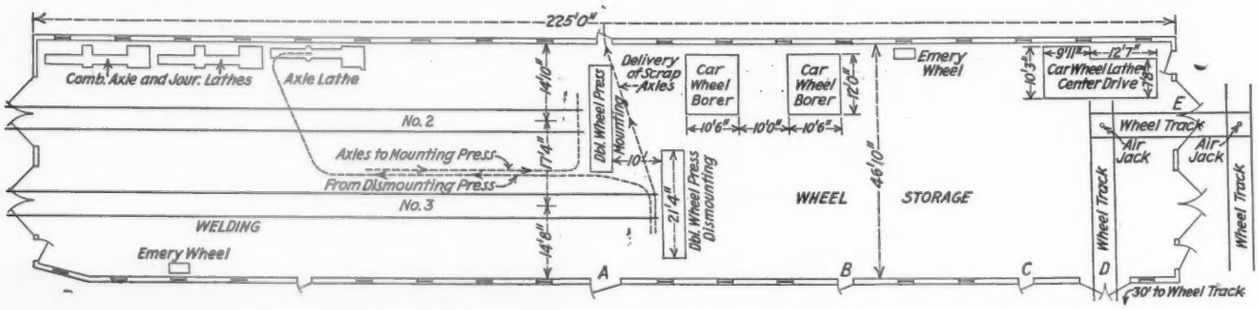
SEVERAL months ago the management of the car department of the Delaware & Hudson started active work on the reorganization of its car repair facilities with the principal object of obtaining better coordination with the freight and passenger car requirements of the railroad. The first major repair facility placed in operation under the new system was the wheel shop at Oneonta, N. Y., at which point all the wheel work of the entire system has been concentrated.

Oneonta is located on the main line of the Delaware & Hudson, approximately 82 miles south of Albany, N. Y., and 129½ miles north of Wilkes-Barre, Pa., the southern terminus of the road. From the standpoint of traffic, location of interchange points and principal car repair shops, it is a convenient location for centralizing all wheel repairs. A number of 60,000-lb. capacity gondola cars of wooden construction have been re-inforced and the sides of the body have been cut down for use in the shipment of mounted wheels to and from outlying points. Two of these wheel cars are shown in one of the illustrations.

At the present time a total of 14 men are employed at the Oneonta wheel shop who work under the supervision of a foreman and one assistant. All the work is performed on a piece work basis. Under normal operation the shop has an output of over 3,000 pairs of wheels per month. The machine tool and shop equipment consists of the following:

1 Betts-Bridgeford combined axle and journal lathe.
1 Betts-Bridgeford axle lathe.
2 Niles-Bement-Pond 500-ton double end hydraulic wheel presses.
2 Niles-Bement-Pond 48-in. car wheel boring mills.
1 Niles-Bement-Pond 42-in. car journal truing and axle lathe.
2 Double head emery wheels.
1 20-ton bridge crane, 35-ft. span.

The location of these machine tools and the bridge crane is shown in one of the drawings. One of the hydraulic wheel presses is used for dismounting, while the other is used for mounting wheels. All of the machine tools are electric driven, the two car wheel boring mills being provided with push button control.



Layout of the machine tools and equipment—Monorail system is shown in broken lines

Adequate handling equipment expedites production

In addition to the equipment mentioned in the preceding paragraph, the shop is well provided with jib cranes and air operated hoists to reduce all handling by manual labor to a minimum. Three separate overhead monorails are installed, one of which is used to transport axles from the dismounting press to the axle lathe, one to carry axles from axle storage to the mounting press, while a third is used for the delivery of scrap axles from the dismounting press.

The provision of adequate material handling equipment is undoubtedly one of the important factors in expediting production. Wheels shipped to Oneonta from outside points are transported in special cars which are spotted under either end of the bridge crane runway.

Unloading wheels shipped in from outside repair points at the wheel shop at Oneonta

The bridge crane is provided with special hooks so that three pairs of wheels can be unloaded at one time. The arrangement of unloading tracks in relation to the bridge crane runway makes it possible to unload two cars at

A depressed track facilitates the loading and unloading of wheels and axles

one time; for example, three pairs of wheels can be lifted from a car on track No. 4 and placed on track No. 3. The crane can then move over to track No. 1, take three pairs of wheels from the car spotted on that track, place them on track No. 3 and continue to track No. 4 for another load. This movement can be reversed when loading wheels from track No. 2, it being comparatively easy to load on either track, No. 1 or No. 4.

Storage tracks are provided under the bridge crane runway for the storage of defective wheels in the area between tracks No. 2 and No. 3 or of wheels ready for service in the area between tracks No. 1 and No. 2. A wood platform constructed of reclaimed planking from the sides and ends of wood and composite gondola cars, is built under the crane runway area, the entire width of the wheel shop. This platform, which is built at a level with the top of the rail, makes it easy to handle wheels from one track to another by means of wheel sticks.

Routing wheels through the shop

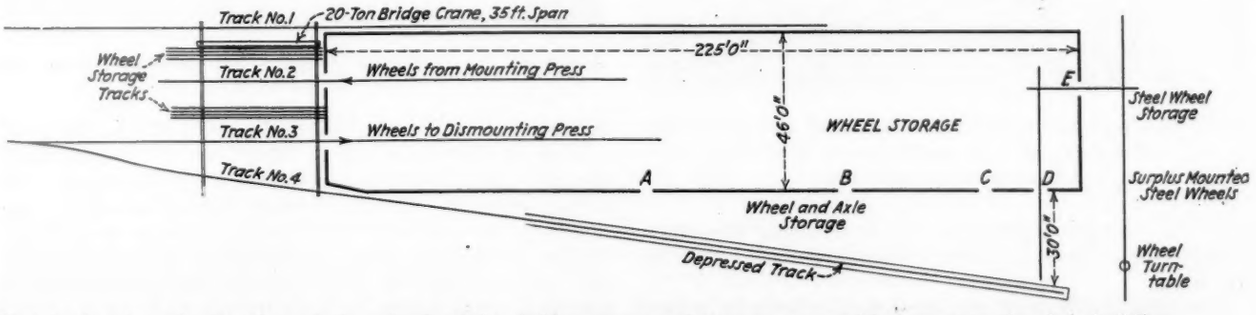
Wheels to be repaired are unloaded to track No. 3 where they are inspected by the wheel shop foreman or

Interior of the wheel repair shop

his assistant as they are routed to the dismounting press. The inspector gages each wheel and axle and indicates thereon by chalk mark whether it is to be scrapped or, in case of a worn axle, if it is to be built up by welding. All welding of worn axles is performed in the shop in the area adjacent to track No. 3.

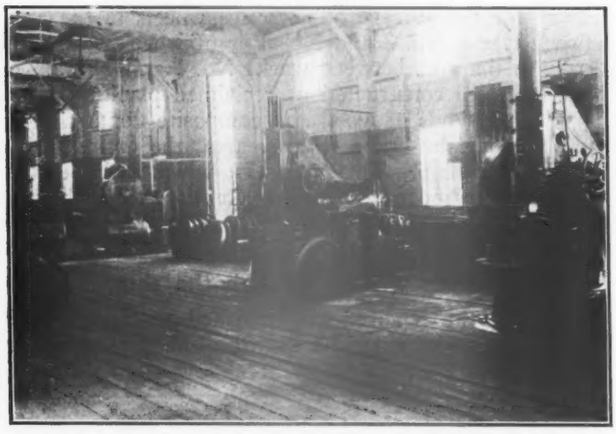
Axles to be turned are taken from the dismounting press to the axle lathe via an overhead monorail which is provided with an air hoist. Scrap wheels are taken through door *A* and loaded in cars on the depressed track. Scrap axles are also taken from the dismounting press by an overhead monorail, as shown in the drawing, and loaded directly in a car or stored outside the shop building in case no car is available.

New wheels and axles are unloaded from cars on



Sketch showing the location of the wheel tracks, bridge crane and storage areas with respect to the shop building

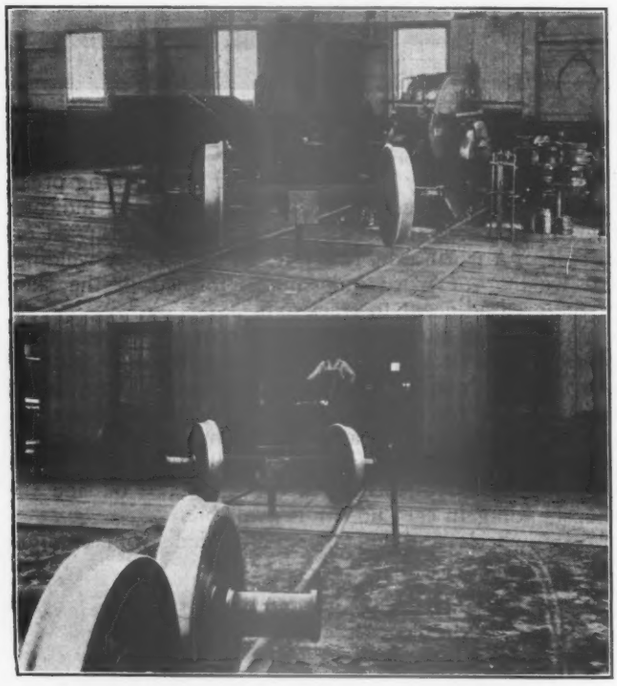
the depressed track and stored in the adjacent area as indicated on the sketch and routed to the two car wheel borers via doors *B* and *C*, as required. A considerable area is also available inside the building for wheel storage, as is shown in the drawing. New wheels are



View showing the two boring mills and part of the mounting press—The roof and upper portion of the side walls are painted white

routed directly from the boring mills to the mounting press or are stored in the rear of the dismounting press until needed.

Turned axles are piled on the floor under the monorail and are taken from here to the mounting press as required. Mounted wheels are rolled on track No. 2



A pair of wheels enroute from the car wheel lathe to storage —Revolving air operated jacks are provided at all track crossings

from the mounting press to the area under the crane runway where they are either stored or loaded directly into a car.

The lathe for turning mounted steel wheels is located in the rear of the wheel shop. This location is especially advantageous for this work as mounted wheels can be unloaded from the depressed track and rolled directly to the lathe through door *D*. When the work of turning has been completed, they can be taken directly to storage via door *E* or through door *D* to be loaded for shipments. The location of the storage area makes it comparatively easy to load mounted wheels on a car spotted at the extreme end of the depressed track. Revolving air-operated jacks are provided at each of the track intersections and a small turntable is also located, as shown in the sketch, from which wheels can be rolled to the car or to any location in the wheel storage area.

The interior of the wheel shop is painted white and trimmed in gray which gives a pleasing interior appearance and assists materially in reflecting light. The building is lighted at night with 57 200-watt electric lights. Scrap from the different machine tools is loaded into bins on platforms designed to be transported on electric trucks of the lift platform type.

Safety first in framing refrigerator cars

WHILE rebuilding a series of refrigerator cars at the Denver shops of the Denver & Rio Grande Western, it was found that in fitting the framework together there was danger of the carlines falling out before they could be secured with the cross-rods, and thus injuring the workmen.

To hold the carlines in place until the cross-rods could be applied, the device illustrated was employed. It

A simple rig to prevent carlines from falling before they are secured in place

consists of a forked section of ½-in. by 2½-in. bar with a hook at the upper end to hang over the side plate of the car. A pin which passes through ⅝-in. holes in the forks, supports a 2-in. by 6-in. plank, which in turn holds up the carlines. The hooks are made of sufficient length so that the plank passes along the underside of the carlines. As the 2-in. by 6-in. board is inserted in the forks from below, it is easily removed by removing the pins from the fork.

C. R. R. of N. J. solves the hot box problem

Insistence on correct practice produces results—New system of oil and waste reclamation

As the result of a study of the two primary factors in solving any hot box problem the Central Railroad of New Jersey reduced the average number of hot boxes per month in freight train service from 1,253.3 during the first six months of 1926 to 481.6 for the first six months in 1927, a decrease of 61.4 per cent. At the same time the average number of freight car miles per hot box per month was increased from 10,369.2 to 28,098.7, an increase of 171.3 per cent. Comparing the same two periods for passenger train service, the average number of hot boxes per month was decreased from 5.6 to 2.5, a decrease of 55.4 per cent. The average number of passenger car miles per hot box per month was increased from 319,498 to 938,059, or 194.7 per cent. The improvement made in car miles per hot box in both freight and passenger service since January 1, 1926, is also illustrated in the chart which shows in graphic form the record for each month to September, 1927, inclusive.

The Central Railroad of New Jersey has adopted a definition of a hot box of the utmost severity in recording its hot boxes. It counts as a hot box any car giving trouble enroute or causing any detention enroute. It also records a hot box against any car which, though it arrives at a terminal without causing any detention enroute, is found to be in need of either a brass or wedge, or packing. It is the opinion of the management that this system gives a more accurate picture of the hot box situation on the road than to consider a box as hot only when it has caused a detention of over 15 min. on a freight train or over five minutes on a passenger train. Estimating the average freight car miles per month on a 15-min. detention basis the average would be from 500,000 to 800,000 car miles.

Delivering "dope" to the reclamation plant to be renovated

Solving the man problem

The greater proportion of the increase in car miles per hot box from April, 1926, to May, 1927, was due to a special campaign of instruction inaugurated by the car department which resulted in the car oilers and inspectors being uniformly and properly instructed on packing journal boxes. A.R.A. recommended practice for packing journal boxes is followed. The next step, which followed immediately the work of instruction, was to see that the men followed the instructions. This was accomplished principally by special checks made by various members of the staff and by the foremen in charge of the various shops and outlying repair points. A drop instead of an increase in car miles per hot box occurred during the first three months of 1927. Corrective measures were applied just as soon as the management was satisfied with the results of the investigation. It was found that considerable of the difficulty was due to a slight relapse on the part of the oilers and inspectors in following instructions relative to the packing of journal boxes, and also that a number of hot boxes were caused by the poor quality of reclaimed oil and packing.

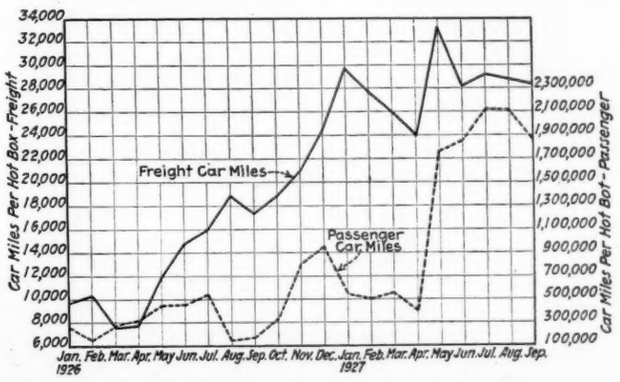


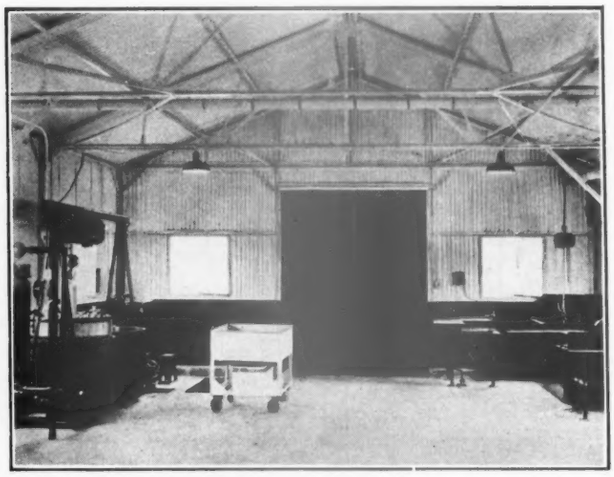
Chart showing the increase in car miles per hot box in both freight and passenger service from January 1, 1926 to September, 1927

Solving the material problem

The need of an improved system of reclaiming oil and waste had become evident some time previous to January, 1927. The cost of car journal lubrication, of course, made it necessary to renovate the material used in car journal lubrication. Although considerable material was reclaimed and put back into service, it was found that its fitness for use was doubtful.

Shortly after the first of this year, the railroad made a contract with the Railway Service & Supply Corpora-

tion, Indianapolis, Ind., to reclaim the oil and waste used in journal box packing on the cars used on its lines. This company erects and operates its own plant, the railroad being responsible only for the delivery of the dirty packing to the plant and the shipment of the reclaimed oil and waste from the plant to the various points where used. The new reclamation plant was



Interior view looking toward the entrance to the waste reclaiming plant—Roll making machine is shown at the right

built adjacent to the car repair shop at Elizabethport, N. J., and was placed in operation in July, 1927. It has an average daily output of 10,000 lb. of "dope," the production of which requires the services of four men working eight hours per day. These men are employed by the operating company and they work on a piece work basis. In addition to these men, one man is em-

Interior view of the waste reclamation plant—Oil and water extractors are shown in the foreground

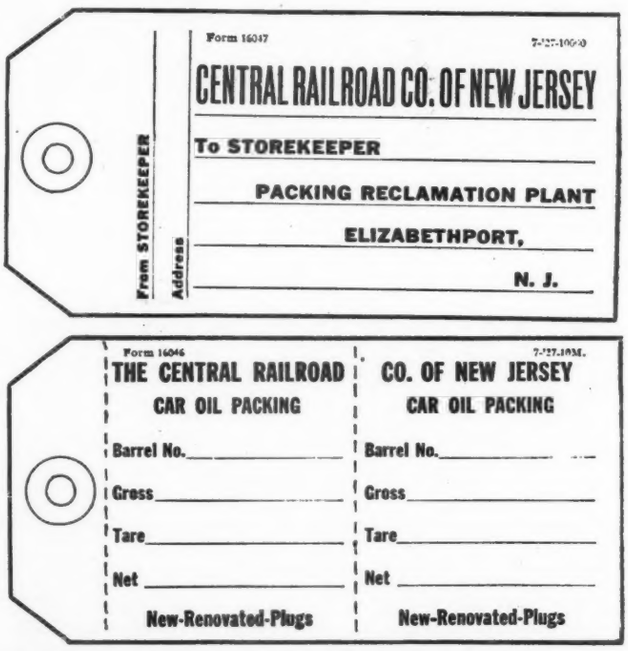
ployed to make packing rolls and another to operate the oil reclaiming plant. The entire plant is in charge of a foreman who reports to the operating company.

System of handling material outside the plant

The car and locomotive departments ship dirty packing from outside points to Elizabethport which is unloaded in a building adjacent to the reclamation plant. This building is also used for the storage of new waste and is under the jurisdiction of the stores department. One man unloads the incoming waste and keeps a record by weight of all receipts and disbursements. Shipments to and from outside points are made in steel bilge barrels, provided with removable heads.

Special shipping tags for incoming and outgoing shipments are provided. Spaces are provided on these tags for the number of the barrel and for the gross, tare and net weights. The outgoing tag is perforated at the center and the same information is entered on each half. When the barrel is loaded on a car for shipment, the outside half of the tag is torn off and sent to the stores department for record. The inside half is removed from the barrel on arrival at destination and is retained by the receiving department for record. The contents of each barrel is also indicated on each portion of the tag by crossing out two of the three words printed on the lower part of each stub. For example, if the words "new" and "plugs" are crossed out, the barrel contains renovated packing.

An electric hoist carried on an overhead monorail,



Top—Tag for incoming barrels. Bottom—Tag for outgoing barrels

shown in one of the illustrations, is used for the handling of material between the stores department's building and the plant. New oil is received in tank cars which are unloaded into the clean oil tank located adjacent to the oil reclaiming plant. The location of the spur track in relation to the various units comprising the reclamation plant, is shown in one of the illustrations.

Reclaiming the waste

The system of routing material through the reclamation plant is shown in the drawing. Dirty packing is delivered via the monorail direct to the scales, located adjacent to the entrance, where it is weighed. From there it is taken direct to two heating tanks where it is heated in its own oil to 200 deg. F. The next step in the routing of the dirty waste is from the heating tanks to the oil and water extractors in which the oil and water is separated from the waste, the liquids going to the dirty oil storage tank placed beneath the floor. From the extractors the waste goes to the cleaner and dryer where

the dirt, moisture and short ends are removed, and thence to a shaking tray where the waste is fluffed up and inspected. From the shaking tray the waste is taken to the impregnator for resaturation, from which it goes to the scales to be weighed and taken to the stores building for shipment.

The Railway Service & Supply Corporation maintains a log of the performance of each plant it has in operation. In addition, it keeps a record of all packing received at the plant and daily reports are rendered to the railroad and to the home office of the amount of packing received and the weight of rolls saturated.

Arrangement of tanks used in the oil reclaiming plant

It will be noted from the drawing that the roll making operation is performed outside the regular routine of waste reclamation. At this plant all rolls are made from new waste. The railroad places greater service value on the reclaimed waste for loose packing than on the new, owing to the fact that the renovated packing has gone through three stages of saturation. Briefly these stages consist of the following: the original saturation when mixed new, the saturation which is received by the drawing of the oil to the journal when in service, and the saturation during the process of reclamation of the oil, the first step being to mechanically throw through the waste all of the oil removed from it under pressures equivalent to 125 lb. This final stage forces oil to the center of the fiber and then resaturates it under the process of vacuum and pressure.

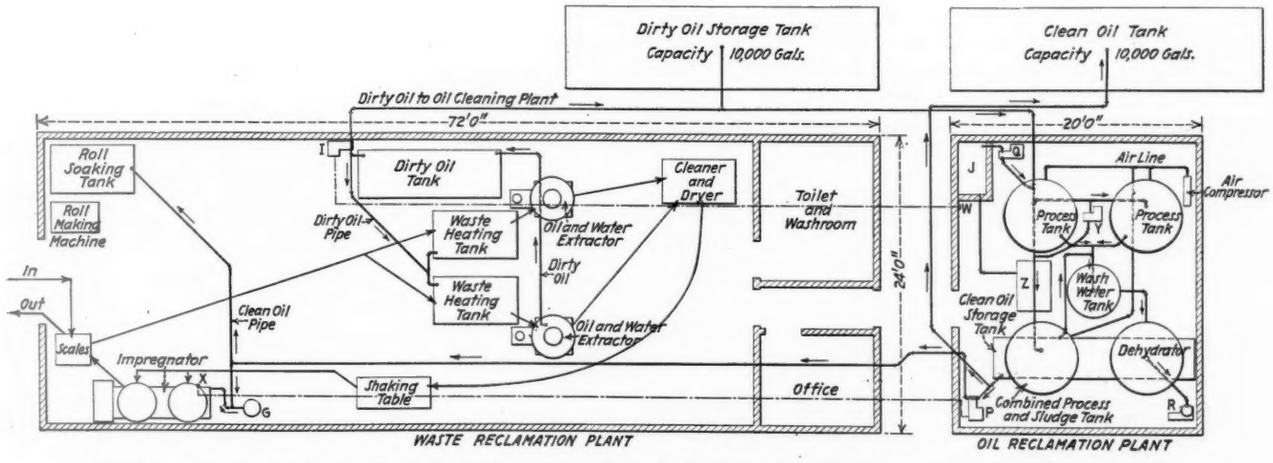
Reclaiming the oil

The dirty oil is pumped from the storage tank in the waste reclamation plant to a large storage tank of 10,000 gal. capacity, located outside the buildings, or to the oil reclamation plant as required. The oil cleaning process is carried on in two process tanks. The center tank contains water for washing the oil and the tank in the corner to the right of the door serves as a combined process and sludge tank. The tank opposite is a dehydrator and serves to remove moisture from the oil. The clean oil is stored in a tank which is located under the floor. The chemical tank is also placed underground.

An idea of the system followed in cleaning the oil can be obtained from the functions of the various pumps shown in the drawing. Dirty oil is pumped to the oil reclaiming plant by pump which is located at the end of the dirty oil storage tank in the waste reclaiming plant. This pump is also used to replenish the waste heating tanks when necessary. Pump is a vacuum pump used in connection with the process of removing the moisture from the oil. Pump is a chemical pump for pumping the cleaning chemical, which is a caustic solution that acts as a deterregent, to the process tanks. Pump *Y* is a sludge pump for removing the sludge from the process tanks.

Pump *P* forces clean oil from the clean oil storage tanks to the impregnator in the waste reclaiming plant. It is at this point that the reclaimed waste and reclaimed oil are again united. Residue from the oil reclamation process is used for center plate grease.

The following sample analysis of the reclaimed oil shows that it compares favorably with new oil: dirt residue, none; flash, 365 deg. F.; burn, 415 deg. F.; reaction, alkaline; gravity, at 60 deg. F., 881; moisture, slight trace; viscosity, 518 sec. at 100 deg. F.



Equipment layout of the oil and waste reclamation plants—The arrows show the routing of the material

Summary of the oil and waste reclamation process

The following is a summary of the reclamation process as carried on in the plant. Dirty packing of an unknown content of oil is received at the plant. The oil or liquid from the inbound packing is separated from the solid part, or waste and dirt. This operation requires careful control inasmuch as the waste leaving this process for

further cleaning must contain its normal fiber saturation. This requires that the mass under separation be at a certain temperature and be subjected to a definite centrifugal action for a definite period of time. These conditions bear a definite relationship to the product desired.

Waste is cleaned by the removal of dirt and short ends and is subjected to an air blast of a pressure, quantity and temperature to remove the moisture and restore resilience. Dirty oil is subjected to a chemical process of renovation whereby all matter extraneous to the oil as a good lubricant is removed.

Cleaned oil and cleaned waste are next brought together in their proper ratio and saturated at a controlled temperature, the process involving first a vacuum, and then a pressure. The clean packing leaves this process saturated with a known quantity of oil and is ready for service.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

The recording of correct axle dimensions

On October 16, 1923, the Southern Pacific changed a pair of wheels on the Chicago, Burlington & Quincy car No. 45015, and applied a second hand axle, giving the dimensions of the journal length as 9 in. On December 28, 1923, the Gulf Coast Line changed the same pair of wheels on account of being slid flat and charged the owner for second-hand wheels less the scrap axle removed, giving the journal of axle as 9⅝ in. The wheel numbers confirmed that the pair of wheels removed by the Gulf Coast Line was the same pair applied by the Southern Pacific a little over two months previous. The Southern Pacific declined a claim for a scrap axle applied, based on the evidence of the Gulf Coast Line wheel and axle repair card, stating that its records showed a 9-in. journal applied, and that the evidence was not conclusive that it applied an axle other than a good second-hand A. R. A. axle. The Southern Pacific also disputed the claim of the C. B. & Q. that it was out of reason to believe that an axle could be O. K. when applied, as its journal length be ⅝ in. greater in two months and 12 days.

The Arbitration Committee stated that, "the axle in question was incorrectly recorded as to journal length, either when applied by the Southern Pacific Lines or when subsequently removed by the Gulf Coast Lines. There is no agreed statement of fact in relation to the journal dimensions and the Committee is unable from the evidence before it, to decide with which road the responsibility rests. The owner is not at fault. The Committee recommends the responsibility be divided equally between the Southern Pacific Lines and Gulf Coast Lines.

"In view of the circumstances surrounding this case, the Committee again directs attention of all concerned to the importance of accurately recording and reporting journal and wheel seat dimensions to the end that similar cases may be obviated."—*Case No.* 1478—*Chicago, Burlington & Quincy vs. Southern Pacific.*

Responsibility for fractured tank head

On December 2, 1922, while Union Tank car No. 1471 was being switched by the New York, New Haven & Hartford, the head burst, the fracture extending 48 in. and 1 in. outward, and also nine 1⅛-in. buffer rivets were loosened. The New Haven claimed that the car was not damaged by unfair usage as set forth in Rule 32, and neither was there any damage on the car which would bring it within the scope of the foot-note of Rule 43. A joint inspection was made with a car inspector of the New York Central who was unable to see any evidence of unusual handling of this car. The car was ordered returned to the owner and delivered to the C. R. R. of N. J. which did not request a defect card in view of the fact that there was no evidence of rough handling. The owner contended that the New Haven was in error in its contention that the head burst due to internal pressure, for the reason that the car was carrying ink oil and the only exerted pressure on the tank head was the load itself. Thus, the damage to the car must have occurred while being improperly handled in switching service.

Investigation by representatives of the Arbitration Committee developed evidence that the damage to this car was caused by unfair handling. The delivering line was responsible, per Rule 32, Section (d). The decision concluded with the following note:

"Note—Due to conflicting evidence presented in a number of cases the Arbitration Committee has found it necessary to make special investigation outside of the evidence before it in order to determine, if possible, the correctness of the briefs. This should not be necessary."—*Case No.* 1479—*New York, New Haven & Hartford vs. Union Tank Car Company.*

Car damaged by passing over coupler between rails

On September 3, 1924, Noble Oil & Gas Company's car No. 812 was repaired at the Minneapolis, St. Paul & Sault Ste. Marie shops, for which a bill was rendered for the renewal of a broken reservoir, triple valve body, dirt collector and various other items of repairs. The repairing line maintained that the damage was caused by the car running over a coupler that was lying between the rails and that the car had not been subjected to any of the unfair usages set forth in Rule 32. The owner refused to honor the bill as it maintained that the damage was the result of a derailment.

The Arbitration Committee stated that, "the investigation by a representative of the committee developed that the damage to this car was due to derailment. The handling line is responsible.

"Note—Due to conflicting evidence presented in a number of cases the Arbitration Committee has found it necessary to make special investigation outside of the evidence before it in order to determine, if possible, the correctness of the briefs. This should not be necessary."—*Case No.* 1480—*Noble Oil & Gas Company vs. Minneapolis, St. Paul & Sault Ste. Marie.*

Basis of computing depreciation of a destroyed car

The Atlantic Coast Line box car No. 24817, 60,000 lb. capacity, built in April, 1904, was destroyed in an accident on November 3, 1925, while in the possession of the Delaware, Lackawanna & Western. The valuation statement showed the car in Class E. The owner claimed that it had been equipped with long metal draft arms.

and argued that settlement should be made for the car on the basis that the case was covered in A. R. A. Rule 112 as a Class E car. The D. L. & W. maintained that the settlement should be made on the basis that the car was in Class F. The D. L. & W. pointed out that the draft arms were built up of one 3½-in. by 3½-in. by ⅜-in. and one 3-in. by 2½-in. by ⅜-in. angle arms, one of which extended back to the body bolster, while the other was 9 in. shorter, one steel casting known as a craft arm and a ⅜-in. plate with a 1¼-in. offset extending up to the top of and on the inside of the wood center sills, between the end sill and body bolster and then back over the bolster to a point 4 ft. 2 in. beyond, all of which were bolted to wood center sills, but there were no direct connections through a metal plate to the body bolster to transmit the shocks to the body bolster and all longitudinal sills, which is the intent and requirement of the rule in order to place a car in the last section of Class E.

The Arbitration Committee stated that, "this construction is within the requirements for Class E cars under Rule 112. The contention of the Delaware, Lackawanna & Western is not sustained.—*Case No.* 1482—*Atlantic Coast Line vs. Delaware, Lackawanna & Western.*

Another interpretation of Rule 32

On July 28, 1924, the New York, New Haven & Hartford made repairs to the Penn American Refining Company's tank car No. 351, which involved the straightening of two metal center sills, renewing coupler stop castings and a coupler striking plate, renewing a type D 5-in. by 7-in. coupler on account of being broken and repairs to a Cardwell draft gear. The owner refused to pay the bill for these repairs, contending that the handling line was responsible under Rule 32, Section (d), which covers collision or impact. The New Haven contended that the car was not derailed, cornered or sideswiped, but was damaged as the result of ordinary switching service and thus, did not come under the interpretations of Rule 32.

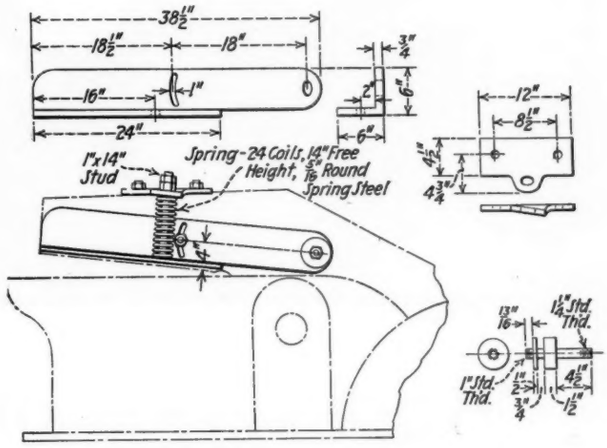
The decision rendered was to the effect that the car was not subjected to any of the unfair conditions under Rule 32 and, therefore, the owner was responsible.—*Case No.* 1483—*New York, New Haven & Hartford vs. Penn American Refining Company.*

Safety guard for alligator shears

THE safety guard shown in the drawing was developed by one of the employees at the Lehigh Valley shops, Sayre, Pa. It was placed on these shears due to the fact that material being cut would often be thrown in the direction of the operator or if not properly held, would be wrenched out of his hands with the possibility of injuring him. This guard insures his safety under such conditions. It consists of a ¾-in. by 6 in. by 6 in. angle attached to the upper shear blade of the alligator shears, which is held in position by a bolt about which it oscillates. When the upper shear blade comes down on its cutting stroke, the angle rests on top of the piece to be cut. A spring is placed above the angle which pushes it down and firmly holds the piece to be cut in place while the cut is being made.

The position of the angle relative to the upper shear blade and the spring is such that the piece to be cut off is held firmly before the blade begins to cut the material and continues to be held until the shear blade has passed it on its return stroke. This eliminates danger of the piece that has just been cut from kicking or flying.

There is no adjustment necessary for the different sizes of material to be cut as the spring takes care of



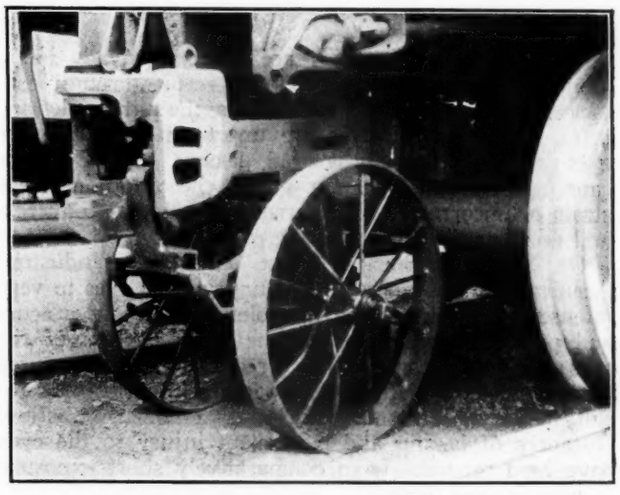
A guard which protects the operator from flying pieces of metal removed by the shears

variations in size within the capacity of the machine. This guard fulfills all the requirements necessary for the safe operation of the machine and the protection of the workman.

A three-wheel cart for handling draft gears

By P. McNamara
General car foreman, Union Pacific, Denver, Col.

THE illustration shows a three-wheel, one-man cart for transporting and inserting draft gears under cars. A great deal of labor is saved in handling by this method as it is only necessary to upend the drawbar and



A one-man cart for handling draft gears

then the lug on the front end of the cart engages the coupler and holds it so that the cart and coupler can be tipped back into running position and taken wherever necessary by one man.

Application of screen glass to welding operations*

Proper filtration of injurious light rays and physical aspects essential requirements

By W. G. King

Director, safety division, American Optical Company, New York

WHEN we speak of a screen or welding glass we mean a glass that is interposed between the eyes and the flame of a welder's torch, or the arc of an electric welder's electrode. The function of the glass is primarily to protect the operator's eyes from the injurious rays emitted by the flame, arc or molten metal, and in addition, through its filtering medium to assist the user to meet his production factor with the least discomfort to his eyes through a reduction of the so-called glare annoyance and at the same time to provide clarity of detail.

That such requirements are necessary leads us to wonder what physiological effects result through contact with the injurious invisible rays, the ultra violet and infra red, when the eyes are unprotected. When the eyes are tired, the body is tired all over; a tired worker cannot be efficient or happy, so that the condition of eye strain or uncorrected visual errors slow down production and decrease the quality of the product.

Dr. Nelson A. Black states in "The Eye in Industrial Accidents," "That exposure of unprotected eyes to very intense light sources rich in violet rays produces acute and painful inflammation of the outer coating of the eyes; that long continued or frequent short exposures to ultra violet radiations of moderate intensity may result in severe inflammation by its cumulative action. Instances of lasting and permanent injury to the eyes have been reported from comparatively short exposure to very intense light."

From another authority in the medical profession we are told that the infra red rays dry out and burn the eves and the skin, producing reddening or irritated eyelids, watering of the eyes and headache and frequently these disturbances are of such intensity as to prevent sleep.

Proper welding glass protects the eyes

The welder on the job recognizes this sensation of burning which is described by him as being like hot sand in the eyes. Those of us having experience in welding operations are familiar with these complaints of workmen, but in recognizing this condition, we sometimes fail to control the conditions through a safety device in the form of efficient welding glass. Undoubtedly, some, if not all of us, can look back a few years when we considered that an ideal welding glass could be made from a series of several pieces of colored glass, usually red, green and blue mounted in layers. Such glass was obtained at the nearest paint or glazier's shop, or perhaps we liked best the color combination of red and blue. Little did we realize that we were offering little or no protection from the invisible injurious infra red rays.

All glass, with the exception of quartz, under most practical conditions, affords protection from the ultra violet. This, however, cannot be said of the infra red. It has been found that clear window glass transmits 78.5 per cent of the infra red rays, while an efficient welding glass transmits less than one per cent. It is also interesting to note that it has been determined that there is only approximately 2.5 per cent variation in the transmission of the rays through thick plate glass over that of the ordinary window glass. It is quite evident from this investigation that the thickness of the screen has little control in arriving at high absorption efficiency, when this thickness is compared with that of welding glass .093 in. thick.

Recently, we learned of a transmission test made on

* A paper read at the monthly meeting of the New York section of the American Welding Society, held October 19, 1927.

welding glass (so-called) built up of several pieces having a total thickness of ¾ in., which transmitted eight per cent of the infra red rays. Frequently in screen glass, thickness may control the depth of shade or density, but it will not necessarily govern its absorption efficiency.

To the casual observer any piece of glass of a dark hue may be a good welding glass if he is looking only toward a reduction of the incidental light and its annoying glare, giving no attention to the vital factors, its absorption efficiencies of the invisible rays. These can be determined only through laboratory tests, for the ultra violet through a spectroscope and the measurement of the infra red through a diathermic ray instrument.

Physical aspects of a good glass

Appreciating the absorption qualities of a welding glass, we can now look toward some of the physical aspects and their relation to the total of a good glass. It must be free from pits, fine holes, creases, stria, or opalescence—factors that produce distorted vision. It should be of uniform thickness throughout and should transmit enough of the incident light to permit the operator to observe the details of his work without eye strain.

It is on this latter point that the establishment of shades or densities has been developed. The personal factor in the selection of welding glass is interesting and should be taken into consideration. The selection of a light or dark shade of glass for the same job is an indication of the variation in the sensitivity of the eyes to the incidental light of the same intensity. As previously mentioned, the shade or density in most cases is a control of individual discomfort. It is for this reason that we frequently hear men say a glass is too light or too dark. It has been shown that the eye is most sensitive to light rays of wave lengths approximately 5,500 to 5,650 Angstroms, producing a color of yellow bearing on the green. Consequently, a welding glass giving this shade enables the welder to observe detail and to do his best work. If the color field approaches either the red or the blue, the operator's perception of detail is decreased and the possibility of the transmission of the infra red is increased.

Selection of the mounting important

In conjunction with efficient welding glass, an intelligent selection should be made of its mounting or container, goggle, helmet or hand shield. If a goggle, it should be of the so-called eye cup construction, conforming to the contours of the face, enclosing the eye at the top, bottom and sides, ventilated, but eliminating the possibility of light leak. The goggle is worn first as a protection from the injurious invisible rays, and secondly as a protection against molten metal splashes or foreign particles. It should be borne in mind that a goggle that might prove ideal on a scrap pile job in the yard, may be wholly inefficient on a job in a firebox of a boiler or inside a tank.

A helmet or hand shield should be designed to afford ample protection to the face, forehead and throat, and made of a material that is a low conductor of heat and not, as sometimes found, made of sheet metal having the contours of an inverted sugar scoop.

To summarize this paper, let me quote our Dr. Charles Sheard: "Welders and those working near high power arcs need protection against the ultra violet, a reduction in the visible and elimination of the infra red. It is necessary for all persons whose work requires exposure of the eyes to excessively bright or highly radiating surfaces to wear suitable light absorbing or protection glasses.

"A filtering glass, which should be used, is one which will cut off both ends of the spectrum, the ultra violet and infra red and which transmits in reduced quantity only rays of high visibility, such as the yellow and green radiations giving the maximum visibility with the minmum reception of energy."

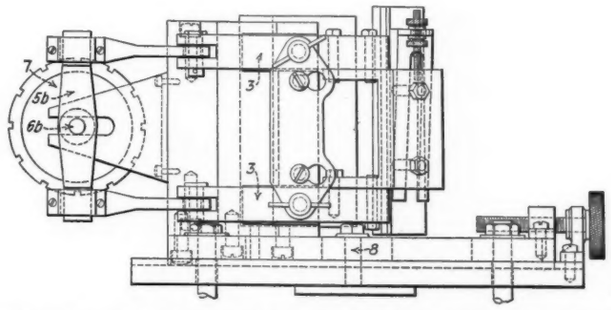
Boring mill jig for clamping removable crown brasses

By L. V. Mallory
Division foreman, Missouri Pacific, Lexa, Ark.

CONSIDERABLE trouble has been experienced in devising a means to hold removable driving box crown brasses for boring. The foreman in charge of this work is confronted with the problem of chucking or clamping the brasses and also of providing an accurate means of calipering the brasses during the boring operation. The author was faced with this problem and solved it by designing the fixture illustrated and described in the following paragraphs.

The jig consists of a vertical vee-block attached to a horizontal plate by means of fillister head machine screws, the heads of which are sunk in counterbored holes on the under side of the plate. This plate also has a raised horizontal boss on its under side that engages with a longitudinal groove channeled in the upper surface of the bed plate of the fixture.

The bed plate has a raised circular boss on its under side that engages with the central hole of the face plate



Side view of boring mill jig for clamping removable crown brasses when boring the journal fit

of the boring mill or lathe on which the fixture is to be used. At points near the corners of the bed plate and located in such a manner that they aline with the four slots of the face plate 90 deg. apart, are the holes through which the anchor bolts pass. Centrally, between these holes are located two other holes, one on either side of the bed plate, that are threaded to receive the longitudinal adjustment securing screws shown at (8) on the drawings.

The six slotted holes in the upper plate, three on each side, are in line with similar holes in the lower plate. An adjusting screw with a knurled wheel is secured to one end of the lower bed plate. This screw engages with a fixed nut secured to the upper bed plate. Any motion imparted to the screw will cause a longitudinal motion to the upper bed plate. This feature provides a ready means of adjusting the brass in order to bore the crown brass to the desired thickness.

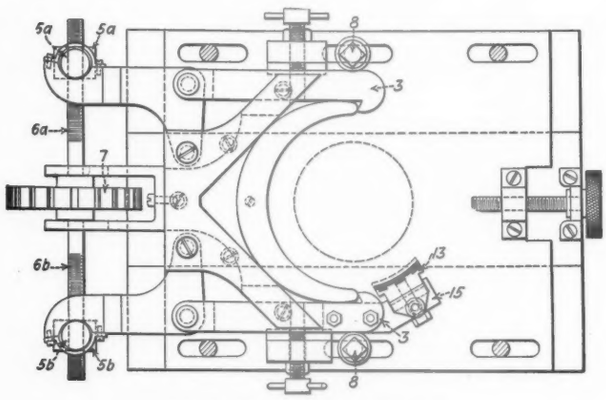
The crown brass is clamped in the vee block by means

of the four clamp bars (3), the ends of which form short acute angle hooks that engage with the edges of the crown-brass. The other ends of these bars are connected to bell-crank levers.

The ends of the short arms of these levers are fulcrumed in receiving slots in the back of the vee-block and the long arms terminate in semi-circular seats on which rest the trunnioned ends of the compression bars (5a and 5b). The compression bar has a hole drilled transversely through its center and is tapped out to engage with the right hand threads of the clamping screw, while its mate is drilled and tapped to engage with the left hand threads of the screw.

Centrally mounted on the screw-shaft (6a and 6b), is the operating wheel (7), which is slotted circumferentially to engage with a spanner wrench for tightening the brass in the jig.

The caliper rest attachment (13-15), is secured to the right hand clamping bars as shown. The angle of the supporting block (15), is such that the babbitted surface of the caliper rest block (13), is held in the path of the boring tool at a point substantially beyond the transverse center line of the brass, thus affording an accurate means of calipering the bore. As the length of the calipering block is equal to or greater than that of the brass, the



Top view of boring mill jig

bore can be calipered at any point between the ends of the brass, a feature that will be appreciated when boring brasses to fit tapered journals.

The calipering block is adjustably secured to the supporting bracket by cap-screws. Adjustment is secured by the use of the divided wedge which rests in a tapered channel in the face of the supporting bracket. The wedge is raised or lowered by means of the knurled nuts which engage with a screw.

Stiffening bars are attached to the outer edge of each wing of the vee-block. The one on the left wing is permanently secured by cap screws while the one on the right wing is secured by shouldered fillister cap screws which engage with slotted holes in the stiffening bar. Winged set screws in each end of the stiffening bars are brought to bear against the clamping bars just prior to the application of the spanner wrench to the screw shaft. This prevents the legs of the crown brass from spreading when pressure is brought against them, thus insuring a true bore.

A small headless set screw may be used to hold the brass a sufficient distance off the bed plate to afford tool clearance when boring through.

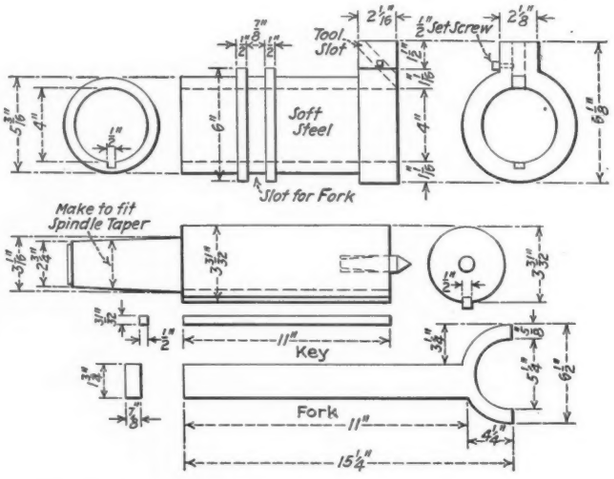
By removing the right stiffening bar the entire assembly of the right clamping bar and calipering attachment may be swung clear when removing or replacing brasses.

Where foundry facilities are available the construction of this jig could be simplified by casting integral the vertical vee-block and upper bed plate. The caliper blocks also could be cast with dove-tailed anchor grooves, leaving only the sides and back of the blocks to be machined.

Tool for turning reverse shaft bearings

By Frank Southwick
Machine shop foreman, Union Pacific, Kansas City, Kan.

THERE are still in operation many locomotives that are equipped with reverse shafts with the bearings outside of the arms. Many shops are not equipped with lathes large enough to swing the reverse shafts between the centers. The illustration shows a tool that can be



Details of a tool for turning reverse shaft bearings

used for turning the bearings of reverse shafts and Walschaert links.

The tool can be used on any 24-in. or 30-in. engine lathe, provided it has a hollow spindle sufficiently large to accommodate the shaft of the tool. It consists of three parts. The body of the shaft which fits into the lathe spindle is made at least one-half larger than the diameter of the bearing to be turned and twice the length of the bearing. A ½-in. square key runs the full length of the shaft body. A hardened lathe center is placed in the outer end of the shaft.

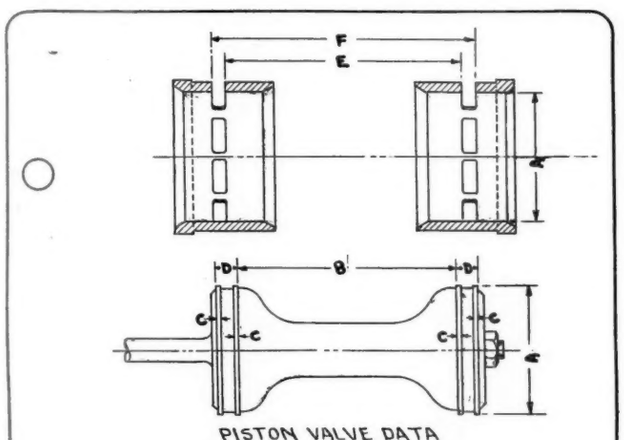
A sleeve with a ½-in. keyway running its full length fits over the shaft. A boss is provided at one end for holding the turning tool. A groove ⅞ in wide is provided on the circumference of the sleeve in which fits a fork that is held in the tool post. When turning a reverse shaft, the tool is assembled by placing the shaft in the lathe spindle and then slipping the sleeve over the shaft. The shank of the fork is placed in the tool post and the fork in the groove on the sleeve. The reverse shaft is then placed between the lathe centers, the cutting tool adjusted and the lathe started. The shaft and sleeve revolve and the reverse shaft remains stationary. The cutting tool is fed over the shaft bearing by the fork which pushes the sleeve along the tool shaft.

Condensed information for mechanical inspectors

A pocket notebook used to compile important data relative to locomotive parts and tests

By Warren Ichler

NEARLY every mechanic, helper, apprentice and laborer connected with the railways, knows, or thinks he knows, the functions and methods of the general mechanical inspector. Yet, if one were to pin down the average mechanical department employee to a definite expression of his thought about the duties



PISTON VALVE DATA
INSIDE ADMISSION VALVES

ENGINE NUMBER	A	B	C	D	E	F	VALVE TRAVL	LEAD	LINK RAD.	VALVE GEAR
350-359	12"	24½"	5/8"	2½"	26¾"	29⅜"	5 13/16"	1/16"	56"	STEPHENSON
630-644	13"	17"	5/8"	2⅞"	19"	22¾"	6½"	3/16"	72"	WALSCHAERT
725-749	13"	21½"	5/8"	2⅞"	23½"	27½"	6½"	1/4"		BAKER

Fig. 1—Piston valve data

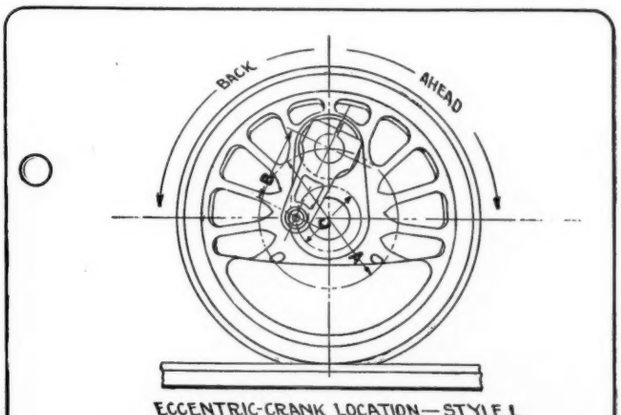
of an inspector, all too often one would find the impression that a mere critic if possessed of some little mechanical knowledge, could fill the position acceptably. Of course, no assumption could be farther from the truth than this. The inspector's duties involve observing, advising, correcting, instructing and reporting—not perhaps in the exact order given though there can be no doubt about the priority of observation in the work scheme, and tact will certainly dictate the placing of the reporting function at the bottom of the list.

It will be noted that the bulk of the inspector's work, that is, advising supervisors, correcting errors of workmanship and false impressions about standards and methods, and instructing supervisors and workmen in proper methods and procedure, is all of such a nature as to require a broad general mechanical knowledge and a complete knowledge of local standards and methods. The word local, as here used, means those standards localized to a particular road or sub-district of that road.

While no amount of mechanical data can take the place of a broad fundamental training, the knowledge of local standards can be largely compensated for by the generous use of mechanical data. In other words, if a well-trained mechanic were to be appointed as an inspector on a railway with which he had little or no familiarity, his lack of knowledge of this particular railway's traditions, mechanical standards, and needs could be largely offset by supplying him with drawings, copies of system mechanical orders, etc. There is a belief in some quarters, that such a man, entering on his work with his viewpoint and personality unbiased by traditions and long established practices is a more valuable inspector to the road than one whose habits and friendships have been locally formed.

The inspector's note book

However true or false this premise may be, the first step taken by any inspector—whether appointed to that position on a familiar or unfamiliar road—is the gather-



ECCENTRIC-CRANK LOCATION—STYLE I.

ENGINE Nº	A	B	C	VALVE TRAVEL	VALVE GEAR
101---125	30"	19"	20¾"	6⅛"	BAKER
201---220	28"	17"	18"	5⅛"	WALSCHAERT
356--360	26"	16¾"	20¼"	6¾"	WALSCHAERT

Fig. 2—A condensed sketch in place of a detailed tracing

ing together of such special information as he deems necessary, into a note book or portfolio. What material shall the inspector's note book contain? Who, besides the inspector, shall have a hand in compiling it? Is it wise to duplicate the work of the mechanical engineer's office by including in such note books matters already

covered by mechanical drawings? It is the writer's purpose to present a few suggestions that have proved of value in his own experiences in similar work.

The writer has always inclined to the use of a pocket-size note book which will account for the 5½-in. by 8½-in. pages shown in the illustrations. Also, the fact that flexibility was preferred above extreme permanency, will account for the loose-leaf binder.

In Fig. 1 is shown a sheet of piston valve data a subject of primary interest not only to inspectors but to supervisors, mechanics and others. Since it is of such fundamental importance in locomotive performance, the matter of steam distribution is generally covered by comprehensive drawings. It is obviously impossible, however, even for the mechanical engineer to depend on these original drawings for the rapid reference work often required of him. Hence, the obvious thing to do with drawing files of such magnitude and importance as those covering the main steam valves and valve bushings, is to condense the salient data into such form that it will be readily available for reference. This is not a duplication of work because only the most important facts have

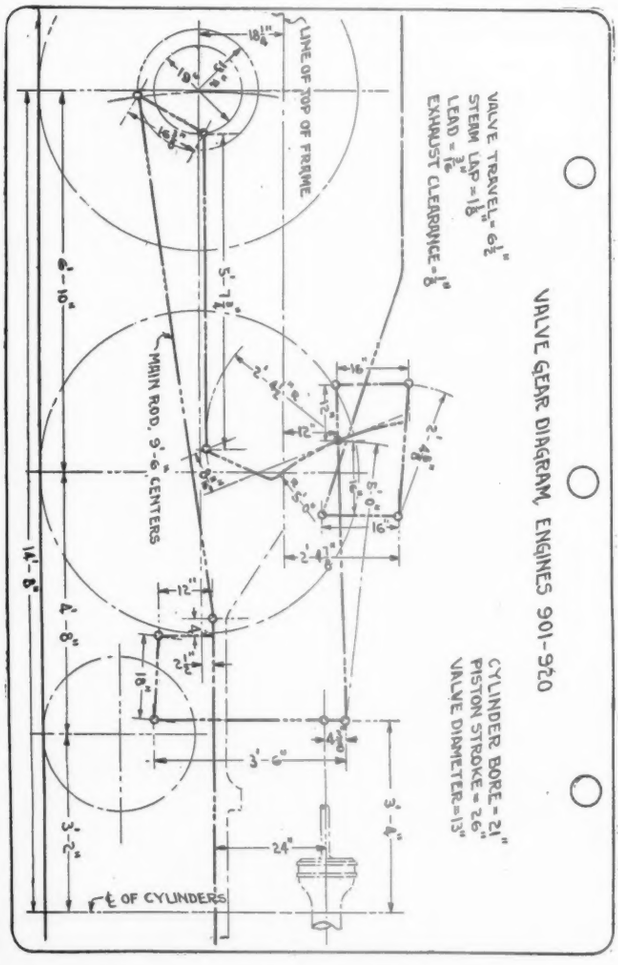

VALVE GEAR DIAGRAM, ENGINES 901-920
LINE OF TOP OF FRAME
MAIN ROD, 9'-6" CENTERS
℄ OF CYLINDERS
VALVE TRAVEL = 6½"
STEAM LAP = 1⅛"
LEAD = 1/16"
EXHAUST CLEARANCE = 1/8"
CYLINDER BORE = 21"
PISTON STROKE = 26"
VALVE DIAMETER = 13"

Fig. 3—Valve gear diagram

been doubly recorded and even then only for widely differing purposes and usage.

In Fig. 2, we have a case where these condensed sketches may be used instead of the elaborate detail tracings. Relative location drawings are the bane of nearly every drafting office in that they require a vast amount of preparatory work before the few significant facts to be recorded on the drawing, can be set down. For erecting machinists, however, they are almost invaluable. This consideration leads to the suggestion that the little drawings furnished inspectors, such as the one shown in Fig. 2, be duplicated by the Van Dyke process and prints furnished for the use of shopmen. While this idea may not find much favor on account of the smallness of the

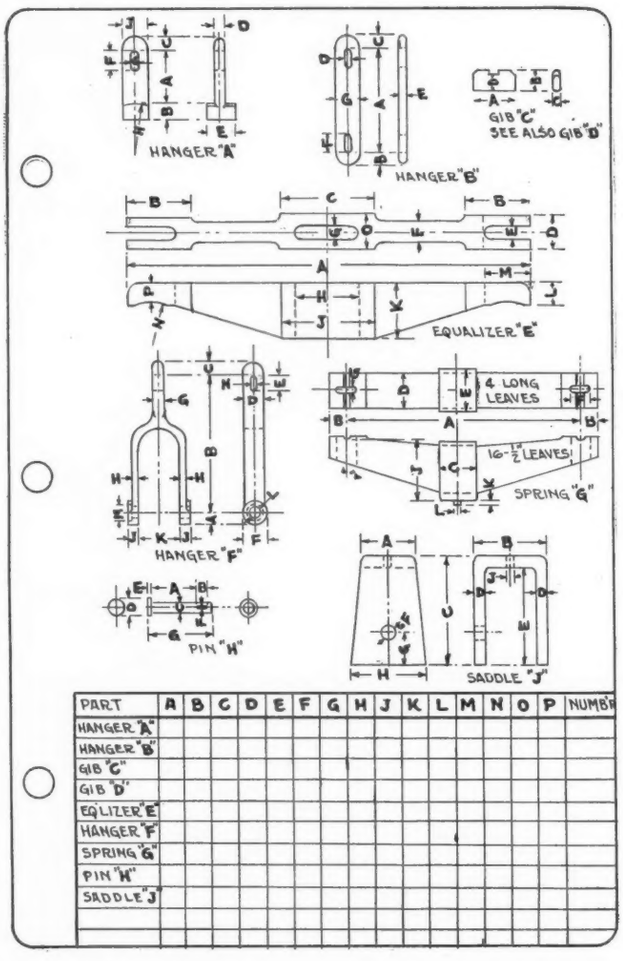


Fig. 4—Spring rigging for an American type locomotive

chart, it has usually been welcomed by foremen and mechanics wherever it has been tried.

On both of the foregoing charts pencil-shading was used to increase legibility and to afford instant recognition when searching for specific subjects in the note book. Since the shading seems to have some little value in duplication by the Van Dyke process, the writer very generally uses it, wherever possible, in note book tabulations.

If one wants to elaborate on relative location drawings still further it is often possible to present, diagrammatically a whole unit of a locomotive mechanism such as the valve gear shown in Fig. 3. It is hardly probable that such a small diagram will find as much favor with shop men as larger drawings of the same unit but for inspection work a diagrammatic presentation of the subject will be found better than a more complete and bulkier drawing.

The inspector should compile individual data

In all that has been said in the preceding paragraphs, there has been no mention of the inspector himself, as an

originator of sketches, charts, diagrams, etc. While the mechanical engineer may usually be looked upon as a sort of editor-in-chief for the material in the notes, the alert inspector will usually be compiling in the same form, a lot of material applying specially to some one district or to a limited number of locomotives. Such data, while probably inapplicable for general use, may well serve in an emergency and be of continuing value until more suitable drawings can be prepared and issued.

An illustration of such a practice is found in Fig. 4, in which the spring rigging for an American type locomotive is shown. Such a sketch as this would ordinarily be a very poor substitute for a working drawing. Yet, just such a sketch, once served as a working drawing and expedited by several days the repairing of an old

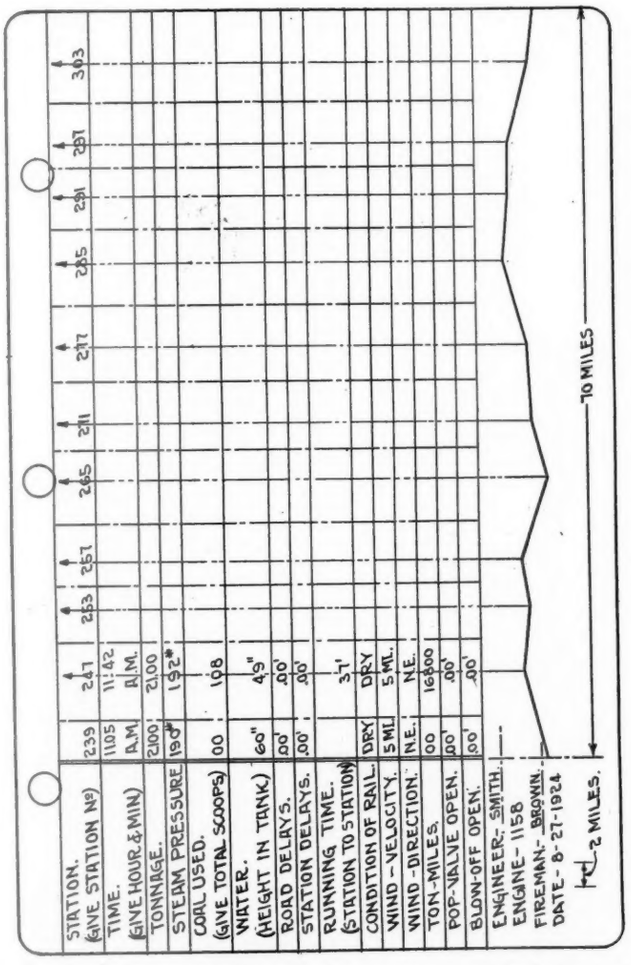


Fig. 5—A typical "log" of engine performance during a test trip

locomotive for which no drawings were obtainable. The locomotive was being repaired at an outlying engine-house where forge shop facilities were almost nil. Since the spring rigging was badly in need of a thorough overhauling, it was decided to make new parts throughout and a sketch similar to that shown was hastily prepared and forwarded to the central shop serving that district. The various forgings came back completely finished and ready for assembly, and later on the salvaged sketch was used as a basis for a working drawing of the standard size used by the road.

Stock castings are in nearly all cases recorded on standard drawings, but in the case of very old locomotives, many parts of cast iron or brass will be found to differ so widely from any material carried in stock that some sort of a drawing will be absolutely necessary for their reproduction. When such emergencies arise an inspector can often originate the drawing without making an expensive special trip to secure the necessary measurements and thus make it unnecessary to send a draftsman from the central office to procure the needed data. It is highly probable, that, with parts of such age as to be entirely unrecorded in the pattern lists and drawing files, the inspectors original sketch will be a sufficient record for all needs during the short remaining life of the locomotive.

Situations, such as that outlined above, are numerous when short lines with unclassified locomotives and undeveloped engineering standards are merged with larger railway systems.

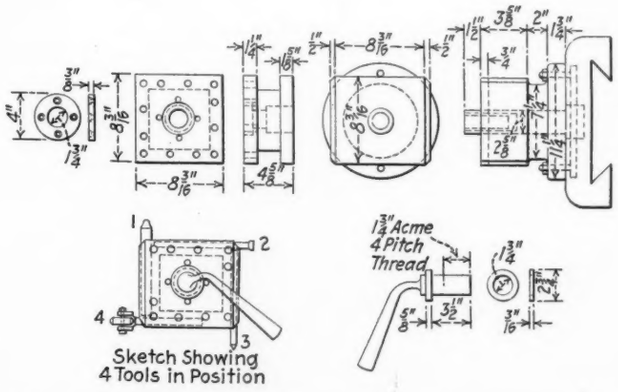
Compiling operating data in the note book

In the mechanical department it seems to be difficult to secure data on a test trip without some discrepancies creeping into the record. The logical defense against them would seem to be a tabular form prepared prior to the test or experiment, in which provision is made for entering each observation of every fact to be recorded.

The form shown in Fig. 5, is a typical "log" of engine performance throughout a trip or parts of a trip. With such a guide before him, no inspector is apt to lose sight of any pertinent data and by recording on the back of the sheet explanations of delays, unusual weather conditions, accidents, etc., a very comprehensive report of the trip can be prepared at any time. It will be surprising to many men who now are recording tests on large elaborately prepared, special forms, how much information can be conveyed by one of these simple, condensed forms and how clean they can be kept when carried in a substantial cover.

Tool post turret for crank pin lathe

THE tool post turret shown in the sketch holds the four tools necessary to complete the machining and finishing of crank pins. This post was developed by one of the employees and is used in the Lehigh Valley



This tool post turret holds the four tools necessary for turning and finishing crank pins

system shops at Sayre, Pa. The tools can be secured in place easily as two turns of the handle releases and raises the turret, which can be readily turned to the tool required and alined by the spring pin for centering. The turret is machined to fit exactly into the base,

thus eliminating all the play that might occur in the post. Each tool is held in place by three 7/8-in. cupped set screws in the turret and the entire post is held firmly by tightening the handle which has a 1¾-in. 4-pitch Acme thread.

This turret tool post may be used for any lathe operation requiring a change of tools, such as valve bull rings, valve chamber bushings, or axles. Its advantages are that the tool need only be removed for sharpening and the time is saved which was formerly used in changing tools.

Device for finishing piston heads

By E. A. Murray

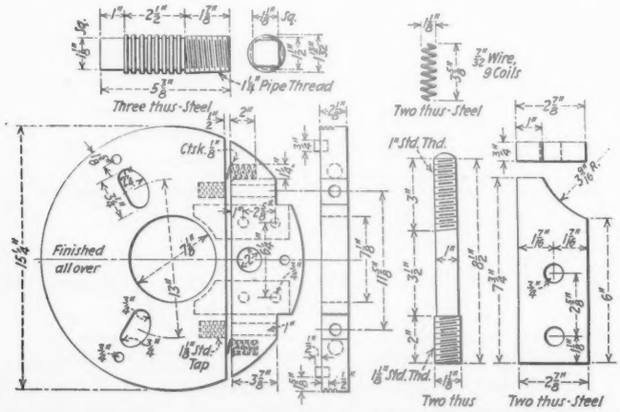
Shop superintendent, Chesapeake & Ohio, Huntington, W. Va.

THE usual practice followed for finishing piston heads is to chuck the casting on the table of a vertical boring mill, machine the top face and part of the circumference, then turn it over and complete the machine work. This method requires a great deal more work than if the cuts were completed at one set-up.

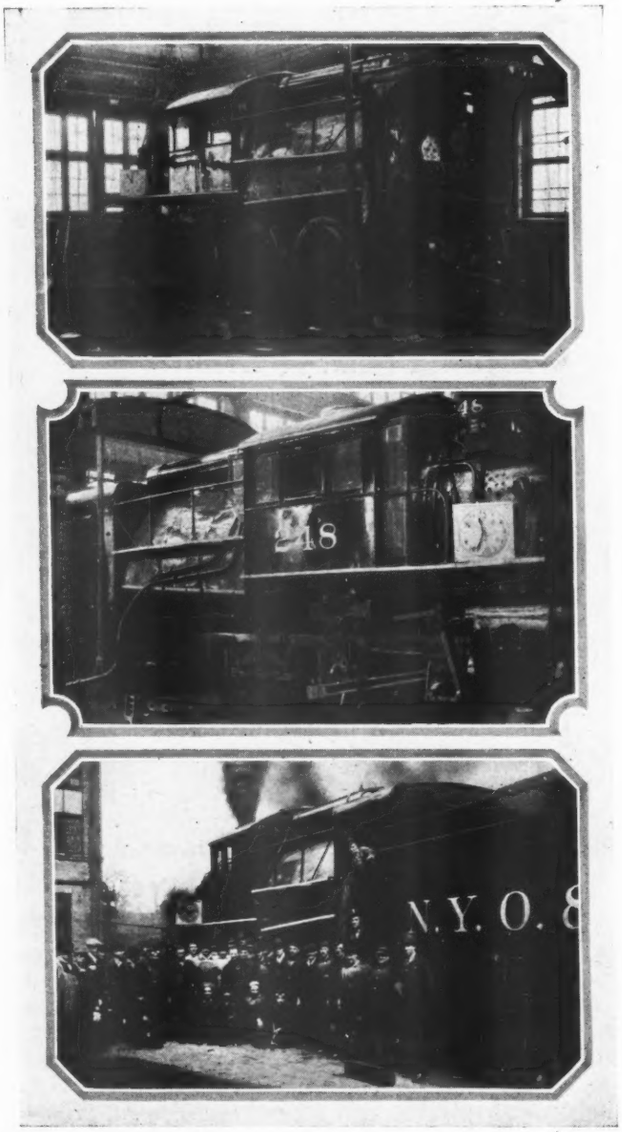
The accompanying illustrations show a device which holds the piston head in such a manner that all of the machine work can be complete at one set-up. The device is made in two parts, the larger of which contains three holes. The 7⅛-in. hole in the center is for the boring bar to pass through and the two oblong-shaped holes together with the 2-in. hole in the smaller part receive the three studs screwed into the bottom of the piston head. The smaller part is attached to the large piece by two 8½-in. studs. The smaller part is free to move on these studs.

When a piston head casting is to be machined, three studs, 5⅜ in. long, are screwed into the bottom side. The chucking device is placed on the chuck jaws of the boring mill. The piston head is lowered onto the device, the three studs passing through the holes in the chuck. The piston head is held firmly on the device by drawing up the two 1-in. nuts on the outer ends of the 8½-in. studs. The chuck is then centered in the boring mill table chuck jaws.

The chuck in the boring mill table jaws ready to receive the piston head



Assembled view and details of a device for holding piston heads on a boring mill



Middletown, N. Y., shop forces of the New York, Ontario & Western make class five repairs to a Mogul type locomotive in 6 hrs., 12 min.

Top—Locomotive at 11:55 A. M. Center—Progress of work at 11:33 A. M. Bottom—Out of the shop and fired up at 2:12 P. M.

Some facts about heat treatment

Not a tempering process but one which changes the texture, strength and hardness of steel

By "Sydney Dunn"

ONLY a few years ago the majority of railroad blacksmiths and shopmen looked upon heat treating as a magic operation or a mysterious and difficult process, not a necessity, but a frill and nonsense. Few practical men have delved deep enough into the subject to appreciate the wonderful and radical changes which will take place in steel by the application of heat at certain temperatures and then cooling it at different rates of speed.

The enormous waste yearly, caused by unnecessary breakage and wear of steel products, could be reduced greatly by a more general use of heat treatment. The extra labor and cost of this treatment is small in comparison to the saving to be had.

It has been my experience to note the prevalent habit of increasing the strength of mechanical parts by increasing their size, instead of using materials more suitable for the purpose and properly heat treating them. No other two factors could reduce maintenance costs such an appreciable amount as these—the right steel for the purpose, and proper treatment employed.

Heat treatment defined

Heat treatment has been more or less thought of as a tempering process instead of one which changes the texture, strength and hardness of steel. It also relieves strains and forms a more uniform mass.

The various elements and their compounds, which are in steel, can be changed in form by the application of heat without reaching the melting point. By element is meant any substance which has not been decomposed into any other simple material.

According to our present knowledge, the earth is composed of eighty-two elements, which occur in various forms. Some of them occur in the native or pure state, while others occur in compound form. They may be gaseous, liquid, solid or amorphous.

Difference between iron and steel

The most common and abundant metallic element is iron, known chemically as "ferrite." Unfortunately, it does not occur in nature in the pure state but as a compound, containing sulphur and phosphorus and other elements. These two elements are necessary evils because they cannot be removed economically. They are not, however, extremely harmful, as they are present in relatively small amounts.

Ferrite comprises the body of commercial iron and steel. It has very little value when pure, for mechanical purposes, due to its brittleness and lack of strength. By the addition of such other elements as carbon, manganese, silicon, chromium, vanadium, molybdenum, titanium, tungsten, nickel or zircon in different combinations, using comparatively small proportions of each to the amount of ferrite, we make steel. By varying the proportions and combinations of each of the above elements in the steel, we can increase or decrease the physical properties in relation to strength, hardness, elasticity, ductility, malleability and fatigue resistance.

The steel may be correct in regard to the quantities of the elements contained, but the form and shape in which they appear in the product has a great bearing on the physical properties mentioned above. In other words, they are not "amalgamated" properly to secure the maximum inherent qualities of the steel.

The function of heat treating

Here is where heat treatment comes in. These non-homogeneous forms and compounds can be changed to the desired size and composition by the application of heat within certain ranges of temperature and cooling at certain speeds.

These applications of heat must be done with a knowledge of the temperature at which the elements will undergo the desired change. The phenomenon may be explained crudely by the simple process of popping corn. A grain of popcorn will not change its form or "pop" until a certain temperature has been reached. This grain of popcorn could be subjected to heat an indefinite length of time and only become seared or parched if the temperature was not allowed to become high enough to make it "pop," and if the grain of corn is heated too rapidly over too hot a fire, the kernel will become burnt without popping. Such is the case with steel and, therefore, in order to secure the required physical properties and structure, we must apply the heat with judgment and subject it to correct temperatures, ascertained through research. By so doing, we can change some very weak or brittle steels to have strength and ductility or strength and hardness without brittleness, or other combinations of physical qualities.

Heat treatment is not only applicable to the finished product, but the process of heat treatment starts with the initial melting or making of the steel. Temperatures in the furnaces, while the steel is in the molten state, must be controlled very carefully and the cooling in the molds must also be at a certain rate. The length of time in which the ingots or blooms are heated for subsequent rolling is also important. It is this latter, bloom, billet or bar form, in which the railroads are mostly interested, as that is the form in which they receive the steel from the manufacturer. You will find that these billets or bars are of various hardnesses, if not heat treated, although they may be of the same chemical composition. Some of them are difficult to machine while others are not, but by a simple process of heat treatment they can be made of a uniform hardness so that they can be machined with equal ease.

Heat treating billets for forging

Heating a billet for forging is also heat treatment and care should be taken in this operation, as the material will undergo a physical change during this heating and working. Too many forge men do not appreciate the fact that rapid and high heat will cause failures, or flaws, to occur in the product. Expansion and contraction are two forces which cannot be harnessed and therefore, if a cold billet is placed in a hot furnace, the sur-

face of the billet will expand more rapidly than the center, which is of a lower temperature and either the surface will crack, or internal ruptures will occur.

The best method to overcome this is to have the billets stored, prior to heating, near the furnace in order that they may become warmed. They should then be preheated at a comparatively low temperature, in a furnace whose temperature is not greater than 1,100 to 1,200 deg. F., for a period of time sufficient to allow the heat to penetrate to the centers of the billets. This time, of course, will vary with the size of the billet, the larger billet naturally requiring the most time. This operation is usually done in a special preheating furnace, or if the layout of the shop does not permit one, the billets may be placed in the forging furnaces in the evening, after the day's forging is completed, after allowing the furnaces to cool down to a temperature of about 1,400 or 1,500 deg. The billets then can remain in these furnaces over night without fire and in the morning the temperature can be raised to forging temperature in about two to four hours, according to the size of the billet.

Care should also be taken that the furnaces are of such a type that the flame does not impinge upon the steel, as this will cause a rapid heating and burning of the surface, while the center is cold. In other words, the surface of the billet is perhaps of a forging temperature while the center is not, this fact again resulting in flaws and a false idea of the plasticity of the metal suitable for forgings. If a pyrometer thermo-couple is placed near the billet under these conditions, a false temperature is obtained, which will give the temperature of the flame and not the billet. The heating should be done by radiation and conduction, and not by contact with the source of heat. If too high a forging temperature is used, the material is weakened, and subsequent heat treatment may not bring this metal back to its proper structure and strength. The same applies to too low a temperature and hammer blows delivered to the material when it is too cold will cause flaws and a weak grain structure which subsequent heat treatment may not change. The manufacturer of the steel is in position to advise the user the proper temperatures for these operations.

Heat treating in the blacksmith shop

The prevalent habit in railroad shops, especially where they have been using iron, is to forge steel at too high a temperature. This is very detrimental to the steel, as it will not stand the high temperature that can be applied to iron. Due to the fact that in the majority of cases the billet cannot be forged into the finished product in one heating, or that it may be too long to be placed entirely in the furnace, it becomes necessary to reverse the piece and reheat. This will again cause a non-homogeneous structure. The different heats and rates of cooling of the piece will cause a variety of grain sizes and different stresses will be set up, which can only be changed or removed by subsequent heat treatment. This is usually done in ordinary carbon steel by annealing. Here, again, is a point which seems to be rather misinterpreted. Annealing is a uniform heating above the point at which a structural change takes place and allowing to cool very slowly, preferably in the furnace. Normalizing is uniform heating above the point at which the structural change takes place, and allowing to cool freely in still dry air.

The points at which these structural changes take place are ascertained by research and this information will be furnished the user by the manufacturer of the steel. If the piece is not heated up to and slightly above this recommended temperature, the required results will not be obtained. It is, therefore, of extreme importance that the temperature of the furnaces should be accurately controlled. This, or any other temperature, cannot be ascertained accurately by the eye. It must be done by electrical or optical pyrometers, which are instruments for measuring comparatively high temperatures. A man may have been a blacksmith or a forge man for 40 years and claim that he can tell temperatures accurately with his eye, but this is not true, as the man's physical condition will cause a variation in his judgment. Bright sunlight, darkness, snow, mid-summer and the various conditions of the weather will not allow him to draw a correct conclusion as to the color in the furnace.

Heating steel to critical temperatures

As mentioned above, the changes that take place in the structures of steel occur only after certain temperatures are reached. These points of change are called critical points.

Some steels have one critical point, others two and some three, and different structures in the material can be obtained by heating slightly above these different points, and cooling slowly or rapidly, as desired. To cool rpidly, it is the usual practice to quench in some medium which will conduct the heat rapidly from the piece. Such mediums as oil, water and brine, and sometimes air, are used to further this end. Slow cooling of the piece after it is allowed to reach any one of these temperatures will also result in a different structure from the original. A structural change is not obtained by drawing or tempering. This drawing or tempering is done by reheating, after quenching for hardening, to some temperature below the lower critical point, followed by cooling.

Importance of accurate heat treatment

Too many failures occur in machine parts from the lack of a correct understanding of heat treatment. For instance, if a driving spring is so manufactured that each leaf in that spring is of a different hardness or structure, it will not give good service owing to the fact that the hardest leaves will bear the most of the load and therefore fail. If correct heat treatment is given these spring leaves, each leaf will bear its share of the load and have the proper resiliency. This can only be done by proper appreciation of temperature and time, in their manufacture.

In repairing various machine parts made of steel, if they are subjected to heat for straightening or welding, they should have a subsequent heat treatment, in order to relieve the strains and also make a uniform structure and strength throughout the piece. Sometimes these pieces may be straightened or repaired by heating to a temperature below the lowest critical point without changing the structure, but if this is done, the whole piece should be heated to the same temperature, otherwise, you will have a different temper at the point which was heated.

Good workmanship is required of the machine shop

Another cause of failure of machine parts is a lack of good machining. Too heavy a cut taken upon a piece may rupture the crystals beneath the finished surface that a subsequent progressive fracture will occur. These ruptures may not be visible to the naked eye but they are readily seen with a magnifying glass or a microscope. Leaving tool marks or abrasions on important pieces which are subject to shock or vibration will also cause failure. Fillets should always be made as large as possible, and no line of demarcation left where this fillet meets the point of tangency. Hammer marks, chisel marks, prick punches, stencils, etc., should never be al-

lowed to remain on a machine part but they should be removed or so altered that they do not form a point where stresses concentrate and eventually result in progressive fracture. All fillets, edges and surfaces should be well rounded and smoothed, and kept in that condition. This not only is an assurance against progressive fracture but it also increases the morale of the men in the shop, in order that they will take better care of these vitally important parts.

To summarize, the important points of heat treatment are the following:

1—Slow heating.
2—Correct temperature.
3—Allowing sufficient time to "soak."
4—Proper temperature of cooling medium.

By bearing these points in mind, together with the fact that "haste makes waste," the mystery of heat treatment is removed and profitable results will be obtained.

Shop tools and devices*

THE machine illustrated in Fig. 1 is designed for grinding exhaust nozzle seats, being operated with a pneumatic motor bolted to the front end of the smoke box. The exhaust nozzle is clamped at the ends of two adjustable rods connected at the other ends to two eccentrics driven by the air motor. These eccentrics are set 90 deg. apart and operation of the air motor gives the exhaust nozzle the desired oscillating motion for grinding it to an accurate fit on the base. This machine is operated by one man with ease and permits grinding the seats in a fraction of the time ordinarily required and with much less physical effort.

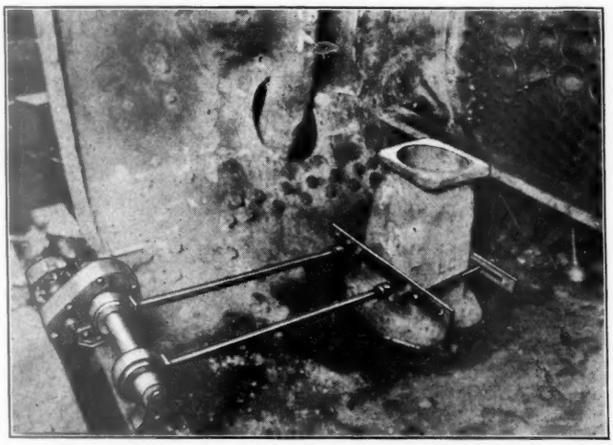


Fig. 1—Mechanical device for grinding in exhaust nozzle seats

Main valve reamer

A line reamer for cross compound air compressor main valves is illustrated in Fig. 2. Some trouble has been experienced in the operation of air compressors, due to the improper alinement of the main valve bushings which causes the piston valve to bind. In order to overcome this trouble, a line reamer has been developed to ream the three different size bushings of the main valve in one operation and in perfect alinement.

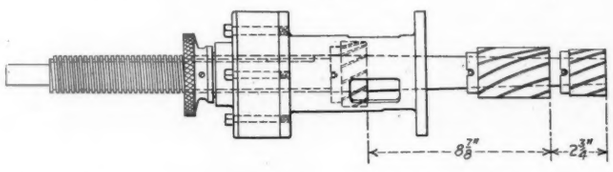


Fig. 2—Air compressor main valve reamer

The practice on the Katy is to ream each bushing to 1/32 in. oversize before renewing the bushings. However, this amount could be increased without impairing the operation of the compressor, thereby creating a nice saving in labor and material.

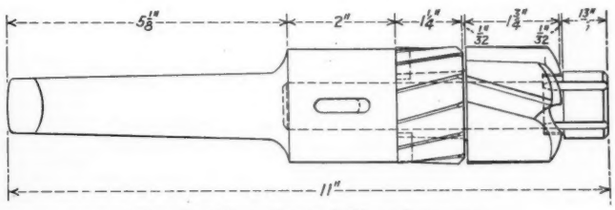


Fig. 3—Flue sheet drill and reamer

The reamer is made up with a long arbor with a four-pitch screw on one end for the mechanical feed, which is obtained through gears in the reamer mounting. A fine feed can be used or a coarse feed if desired. The reamers are of the shell type and can be placed on the arbor in any combination, either standard or oversize, for any of the three bushings.

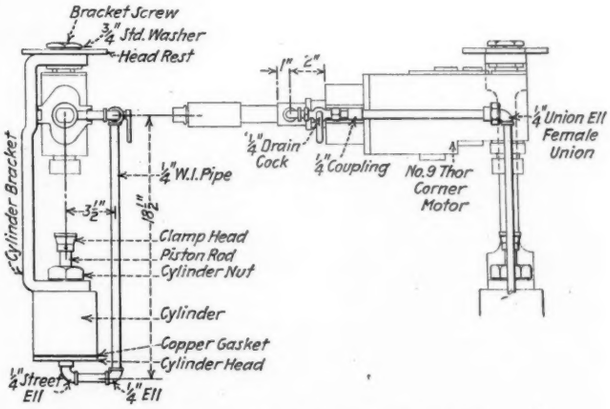


Fig. 4—Flue sheet scarfing machine

The set-up requires the mounting of the reamer on the compressor head with two or four of the regular cap screws removed from the compressor head. The alinement is insured by a boss which fits into the counterbore of the cylinder. After the reamer is mounted it is only necessary to turn the arbor, as the reamer is self-feeding and after the desired depth has been obtained it is advisable to disengage the feed by means of the knurled collar shown in the photo.

After this has been done, turn the reamer two or three

* Abstract of a report presented by W. R. Millican, tool foreman of the Missouri-Kansas-Texas, Parsons, Kans., at the 1927 annual convention of the American Railway Tool Foremen's Association, reports beginning on page 683 of the October *Railway Mechanical Engineer*.

times so that no marks will be left at the end of cut. The approximate time for reaming is five minutes.

Flue sheet cutter

A combination drill and reamer for cutting flue sheet holes is illustrated in Fig. 3.

This is a built-up tool having a removable pilot which makes the regrinding of the drill an easy operation. Another advantage it has over the older type of drill is that the pilot is always kept in good condition which is necessary to produce good holes.

The drill has a taper shank on which the reamer fits,

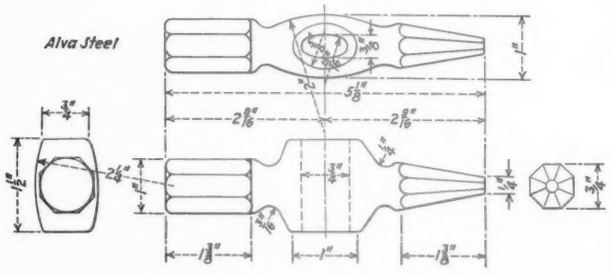


Fig. 5—Locomotive inspector's hammer

and the pilot acts as an arbor for both the reamer and drill. They are held by a taper key through the Morse taper shank of the drill and the pilot shank, which pulls the three together and makes it almost the same as a solid tool.

Flue sheet scarfing machine

A flue sheet scarfing machine of the one-man type is illustrated in Fig. 4. This is an attachment used with a close quarter pneumatic motor and an air cylinder secured to the motor by means of a bracket which automatically feeds the cutter into the work. The amount of feed can be controlled with the drain cock shown. The correct angle of the scarfing can be obtained with the head rest. The throttle of the pneumatic drill is drilled and tapped for a ¼-in. pipe to operate the feed, so that when the throttle of drill is operated it automatically operates the feeding device applied to the drill. One man can easily operate this tool.

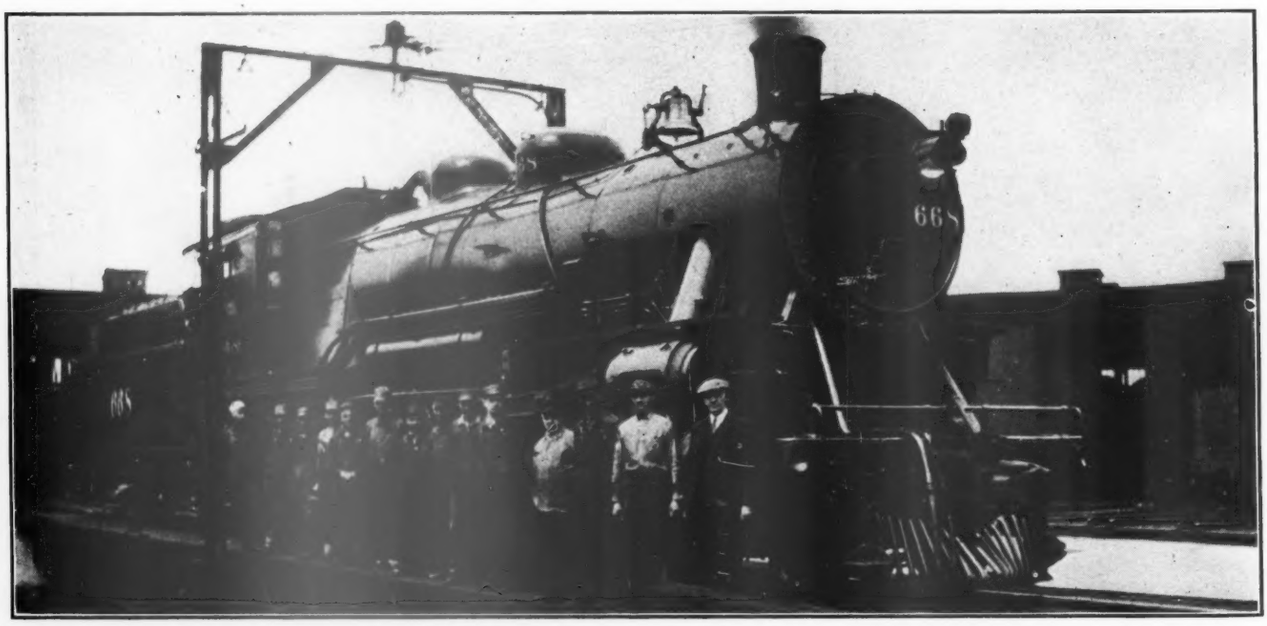
Locomotive inspector's hammer

A hammer used by inspectors in locomotive shops is illustrated in Fig. 5, being designed so that several standard measurements are shown on the handle. This saves the inspector quite a bit of trouble as he can use the hammer instead of having a number of different tools for this purpose. For instance, the hammer is 5⅛-in. overall which is used as a coupler gage. The handle is 14 in. long for the minimum length of the draw bar, etc.

Main driving boxes renewed in 2 hr. 24 min.

By Roy F. Wilson
Chief draftsman, Wabash, Decatur, Ill.

A COMMON mistake made in many enginehouses is that of taking a locomotive out of service for heavy running repairs without having made any plans to care for the work before the locomotive is received. The tendency is to allow the work to take its course towards completion, interrupting occasionally to take the men off the job to work on another which is deemed more important at the moment. The result is that several days are taken to do what ordinarily should require but a few hours. If the proper preparation is made for the regular run of enginehouse jobs before the locomotive is received in the house, and a schedule adhered to, there is no reason why so-called "dead work" cannot be reduced. This is perhaps best illustrated in a case of an emergency repair job performed at the Wabash enginehouse at Decatur, Ill.



Wabash Pacific type locomotive on which the main driving boxes and middle connection side rod bushings were renewed in 2 hr. 24 min.

On May 3, 1927, at 9:38 a.m., Pacific type locomotive No. 668 arrived at the Decatur station with train No. 9. A pound had developed in the main driving boxes which required reboring and crowning out of the brasses. The

middle connection (floating type) side rod bushings needed renewing. This job ordinarily requires from 6 to 15 hours. No preparation was made to handle this work other than to have the rough side rod bushings delivered to the machines and the necessary tools assembled at the drop pit shortly before the arrival of the locomotive at the house.

The force used in making these repairs consisted of four machinists and four helpers on the floor, three machinists on machines, one hostler, the enginehouse foreman and one drop pit foreman. The machines used were not of the most modern type, but varied in age from 14 to 20 years. They are all belt driven and include the following:

1—30-in. American lathe.
1—18-in. Prentice lathe.
1—Niles boring machine.
1—drill press.

The reader will note that only one boring machine was used. Therefore, one of the driving boxes was waiting while the other was being machined. A chronological list of the different operations is as follows:

10:02 a. m.—Locomotive spotted on the drop pit in the enginehouse and work started.
10:15 a. m.—Right middle connection bushing placed on the machine.
10:16 a. m.—Left middle connection bushing placed on the machine.
10:19 a. m.—Eccentric cranks, eccentric rods, main and side rods removed and on the floor.
10:23 a. m.—Main boxes dropped and in the pit.
10:28 a. m.—Right main box placed in the boring machine.
10:41 a. m.—Right middle connection bushing completed with 28⅜-in. holes drilled.
10:46 a. m.—Left middle connection bushing completed with 28⅜-in. holes drilled.
11:01 a. m.—Right main box completed and removed from the machine.
11:02 a. m.—Left main box placed on the boring machine.
11:04 a. m.—Right main box delivered to the locomotive.
11:33 a. m.—Left main box removed from the boring machine.
11:35 a. m.—Left main box delivered to the locomotive.
12:26 p. m.—Rods, boxes, valve gear, etc., all reapplied, cellars and grease cups filled, and the locomotive left the house under its own steam.
Total elapsed time.....2 hr. 24 min.

An accurate check was retained of the actual man-hours required from the time the locomotive was received on the drop pit until it was completed.

Machinist	7 hr.	5 min.
Machinist helpers	3 hr.	18 min.
Enginehouse foreman	1 hr.	47 min.
Drop pit foreman	1 hr.	24 min.
Hostler	....	15 min.
Total man-hours	13 hr.	49 min.
Actual labor cost to perform this work	$9.86	

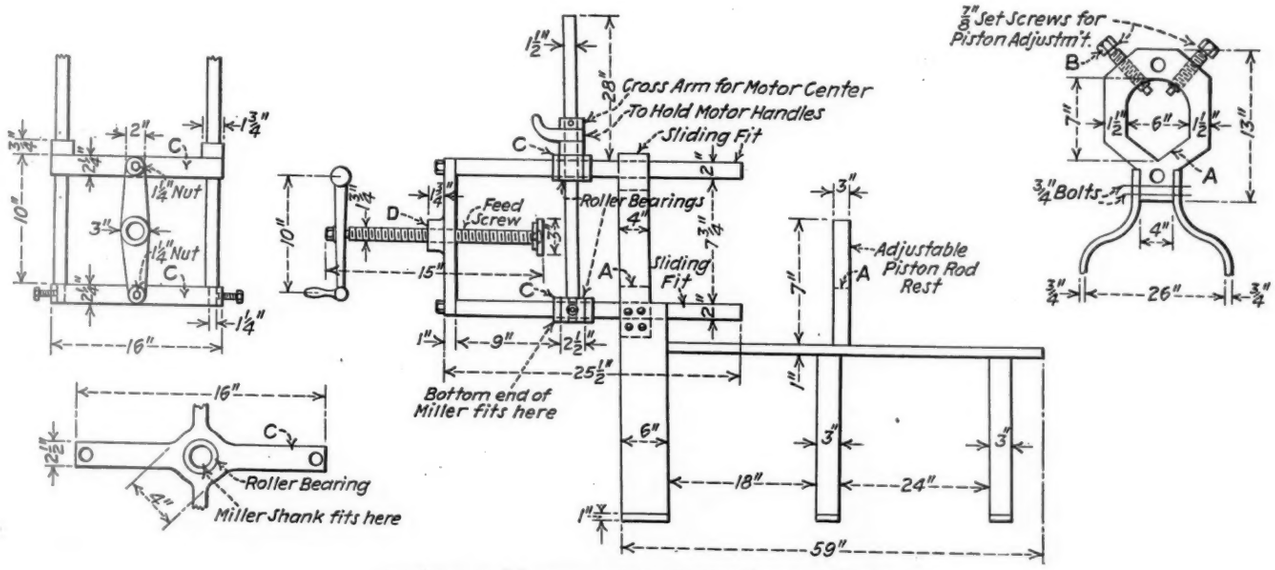
The entire force of workmen did not stay with the locomotive until all the work was completed, but each man was released for other duties as soon as his particular task was performed. The locomotive was dispatched on passenger train No. 50 at 8:25 p. m. and went to Peru, Ind., 173 miles, making a successful trip.

This shows what can be done if the proper preparation is made to handle work of this nature and the workmen are thoroughly trained so that each man knows what he is to do and exactly when to do it.

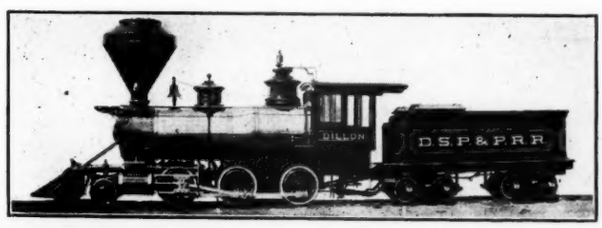
Piston rod keyway cutter

THERE are many small locomotive repair shops in which probably only one piston rod keywey is cut in a month. For such shops, it would not be advisable to invest in a single purpose tool for such a small amount of work. An easily built and accurate machine can be constructed to take care of such infrequent jobs in the small shop.

After the keyway is laid out, the piston rod is placed in the grooves *A*, shown in the illustration, and held in place by two set screws *B*. A pneumatic motor is then placed in position and a hole that has a diameter equal to the width of the keyway is drilled through the rod. A milling cutter with a double end shank is placed through the hole. The ends of the cutter fit in the two crossarms *C*, which are fitted with roller bearings. The air motor is placed on the milling cutter shank. The feed screw *D* is turned so that the end presses against the end of the piston rod, thus making it possible to mill with accuracy and speed any size of piston rod keyway desired.



A piston rod keyway cutter for use in a small shop



One of ten locomotives of similar design built in 1882 for the Denver, South Park & Pacific—Driving wheels, 36 in. in diameter, cylinders 15 in. by 18 in., 3-ft. gage

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Applying cross-key yokes

MINDEN, La.

TO THE EDITOR:

In my letter published in the June issue of the *Railway Mechanical Engineer,* I probably should have said "Rule 88 should apply" instead of "would apply," as it was only an opinion based on my own interpretation of the rules, using the first paragraph of section (c), Rule 3, which requires that the Type D coupler having a 6-in. by 8-in. shank be applied by the owners on all cars built after November, 1920. This coupler can only be applied with a cross-key yoke, and the owner under this rule is forced to maintain this application.

Rule 17, section (a) provides that the handling line may replace defective non-A.R.A. standards with A.R.A. standards provided that such substitution does not impair the strength of the car. (My opinion again.) An A.R.A. standard wrought iron riveted yoke does impair the strength of the car originally equipped with a cast steel cross-key yoke and therefore constitutes wrong repairs, for which the repairing line should issue its defect card for labor only as per Rule 88. This would still penalize the owner for the material when he was forced to correct such wrong repairs to comply with the above-mentioned section and paragraph of Rule 3. (See also interpretation No. 6 to Rule 3.)

Two interpretations covering this matter have been approved by the Arbitration Committee without changing any rules; therefore, it must have been the intent of the present rules. One can scarcely apply any one rule literally.

J. B. SEARLES.

Was Jack right?

The question asked by a reader on this page of the August issue, concerning Jack's conduct in refusing a raise, offered to him by his foreman, has received many answers, but to one who has read them all, it still remains unanswered—that is, unless he has his own answer, which is more than likely to be the case. The discussion of the question has, however, dealt in a very interesting and constructive manner with the qualifications and duties of the foreman, which is, after all, of more importance than to have arrived at a unanimous decision as to the correctness of Jack's conduct. With the two letters below, we bring the discussion to a close. —Editor.

Depends on labor union considerations

CHICAGO, Ill.

TO THE EDITOR:

A few years ago I would unhesitatingly have said Jack did not possess foreman material and that he should have accepted the raise, not caring a whit what anyone thought about it. Possibly I would be quite correct in saying he is poor material now if he worked in any but a railway shop recognizing the National Agreement. Under these conditions I believe he has the correct idea of the present leanings of shop craftsmen.

He believes there should be closer co-operation between men and management. He knows this cannot be achieved where there is discord and if the acceptance of the increase would, as he states (and he appears to be in a position to know), create an undesirable state of mind among his associates, he was right in refusing it. Naturally, being apparently a student of industrial retionships, possibly one of the modern school of advance thinking union men ambitious to become a foreman and having special ability, I would say he is quite worthy material for a trial.

This growing gesture on the part of railway shop craftsmen is very noticeable throughout the country; they have waked up to the fact of the menace the outside industries present in being ready at all times to supply the railways with much material that it has not been customary to purchase and unless they can compete successfuly with these, would eventually find themselves out of a job altogether or working reduced hours.

GENERAL FOREMAN.

Jack and the Golden Rule

DETROIT, Mich.

TO THE EDITOR:

I think Jack could have done a great deal more for those whom he appears to think so much of—"his fellow workmen"—if he had accepted the raise in his pay, for it would have made them see the benefits of doing the same thing Jack was doing.

It has been my experience that in every gang of workers there are invariably certain men who are found to be much better workers who can do their work with less effort, less wear and tear on both tools and machinery, and also with less trouble for the foreman, and who are so recognized by their associate workers. These are the mechanics who get the best class of work and should receive the higher wages. Why should the rest of the gang feel jealous of them because of their own lack of this ability? Therefore, Jack should have accepted the raise offered.

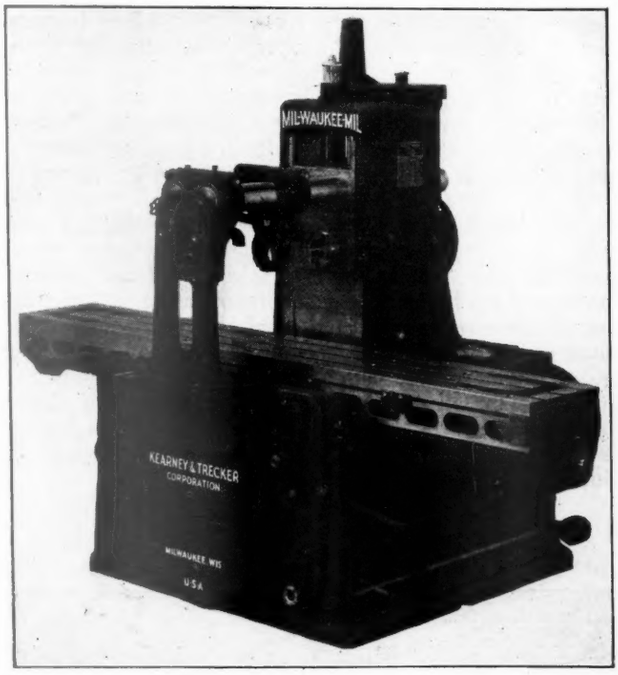
Regarding his being foreman material. My experience as an old gang foreman is that one does not have to pound his men or bulldoze them to get the best results. Do unto others as we would be done by, brings the greatest real results. This does not mean that a foreman should be afraid to censure his men and when giving an order he should be competent to make them understand how and when he wants it done and, if necessary be able and ready to show his men just how to do it. In other words, he must be able to take the lead, not hand them impossible orders or bunk and think he is getting away with it. Give men as good conditions as possible—in machinery, tools, material, surroundings—and an understanding, human boss and very little trouble will be met with in getting the most out of them.

These qualifications I believe Jack has and I can see in him the making of a most successful modern foreman.

EXPERIENCE.

Milling machines built on the unit plan

SIMPLEX and duplex models of a production type milling machine, designated as the Mil-Waukee-Mil, have been placed on the market by the Kearney & Trecker Corporation, Milwaukee, Wis., Both models are built on a unit plan so that a customer



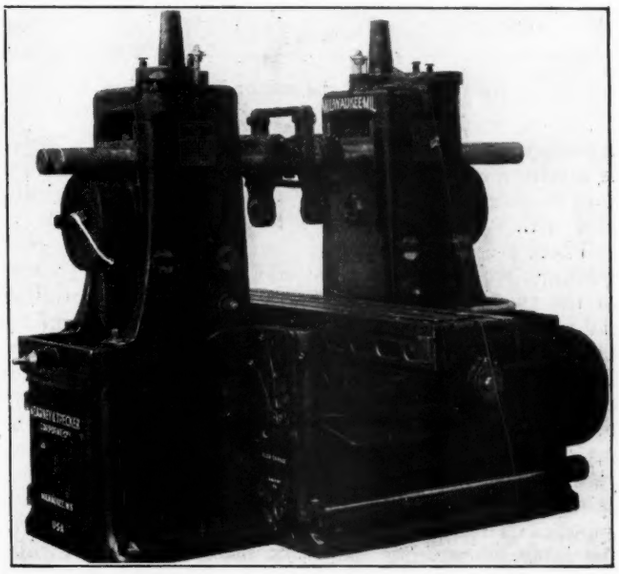
The Simplex model of the Mil-Waukee-Mil milling machine

may purchase only such units as are necessary for any particular operation.

Starting with the simplest forms, which are equipped with but one set of pick-off gears each, for making speed and feed changes, the models can be built up until they become fully automatic with a wide range of intermittent table feeds, power rapid traverse, spindle start and stop controls, etc. The list of standard units that may be applied before or after the machine is in service includes complete sets of pick-off speed gears, complete sets of pick-off feed gears, a quick-change speed gear-box, a quick-change feed gear-box, an automatic feed control, an automatic spindle start and stop control, a spindle reversing unit, a centrifugal pump and coolant system, and a motor-in-bed drive.

Other features of construction include a double housing for the spindle block; double over-arm support for the arbor, Timken tapered roller bearings through the drive, including the main spindle; planer type table, and automatic flood lubrication for the spindle bearings and for all mechanism in the bed, including the table ways.

Referring first to the simplex model, the bed is approximately 4 ft. square and contains two large reservoirs, one for the automatic pump and lubrication system and the other for the cutter coolant and centrifugal pump. The table is 92 in. long by 14 in. wide and is located 32 in. above the floor. It can never be moved



A front view of the duplex milling machine

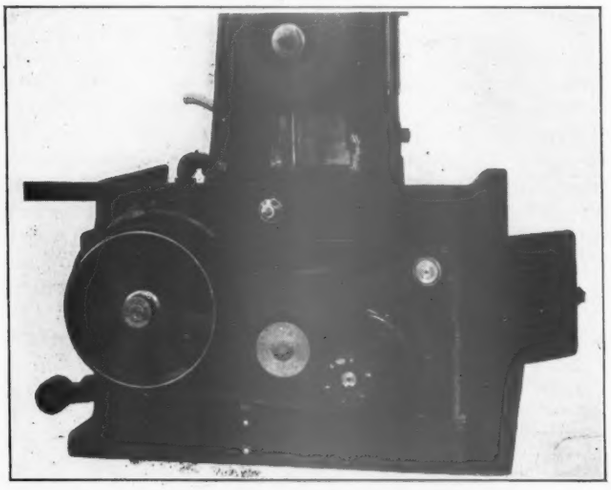
far enough to uncover the ways at either end of the bed, there being always 42 in. of bearing surface length beneath the table. There is a power feed 48 in. in length.

The spindle and double over-arms are contained in a solid block which has a vertical adjustment of 12½

in. between the walls of the double housing. This block can be firmly locked to the housing, the minimum and maximum heights of the spindle center above the table being 3 in. and 15½ in., respectively. This vertical spindle adjustment is accomplished by a screw located at the upper left side of the double housing and provided with a micrometer dial graduated to .001 in. There is also a cross adjustment of the spindle block and housing of 8 in., which is accomplished by a screw at the rear of the bed. This screw is also equipped with a micrometer dial graduated to .001 in.

When either the simplex or duplex machines are furnished in their simplest form, there is a box at the top of the double housing arranged to receive pick-off speed gears. These gears are between two centers only. There is a selection of four different ranges of speeds, 15 to 150, 20 to 200, 30 to 300 and 50 to 500 r.p.m., respectively. In each range, 12 speeds are obtainable with six pairs of gears.

Also, when the two models are in their simplest form, a bracket bolted to the front of the bed at the right end and furnished with a hinged cover, provides a



Arrangement of the motor-in-bed drive

housing for pick-off gears for the table feed. There is a selection of two feed ranges from ½ to 20 or from 1 to 40 in. per min. In each range, 18 feeds are obtainable with various combinations of nine gears.

There are but three control levers on the plain simplex machine, located at the right end of the bed. The upper of the two short vertical levers is used for controlling the power table feed and the lower lever for controlling the power rapid traverse which functions at the rate of 240 in. per min. in either direction. Dogs on the front edge of the table trip out the power feed at either end of the stroke and a third dog can be located to trip the rapid traverse as the work approaches the cutters and just before the cutting feed is engaged. The long lever at the right is for starting and stopping the main spindle. The rapid traverse may be used for returning the table or running the work up to the cutter while the spindle is standing idle. On the plain machines, all controls, except the trip-dogs, are manually operated.

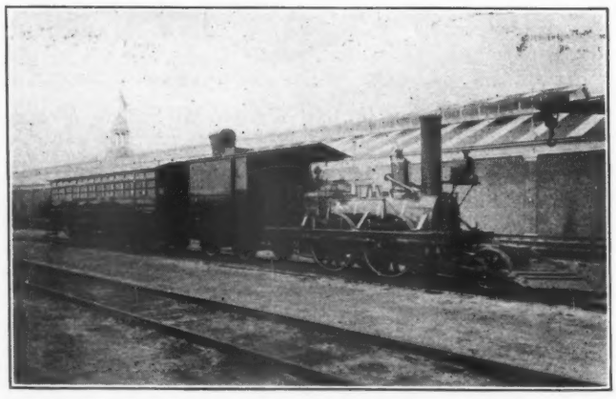
There is a compartment within the bed for a 15-hp. motor. In this position, the motor is accessible both from the side and back of the machine through ventilated doors. Power is carried from the motor by a 5-in. belt to a pulley driven at 600 r.p.m. A weighted idler automatically provides the necessary belt tension. When arranged for a belt drive from an overhead lineshaft, the machine pulley is mounted on the same initial drive shaft, but a 4-in. belt is used.

The duplex machine is identical in construction with the simplex model, with the exception that the bed is extended beyond the tableways for attaching the second or left head. All the mechanism within the bed is the same as in the simplex model, excepting that the horizontal drive shaft extends all the way through to connect with the bevel gear on the vertical drive shaft for the left spindle. The drum control for the automatic table feed is moved forward so that instead of being directly at the front of the bed, as on the simplex machine, it is located at the left end of the duplex machine bed casting.

The quick-change feed gear-box is bolted into the right side of the bed back of the table. Like the speed box, it is of the sliding-gear transmission type and has three control levers and a direct-reading plate. Eighteen feeds, giving a range of from ½ to 20 or from 1 to 40 in. per min. are available.

The automatic feed control unit is in the form of a drum that is accessible through the large door at the front of the simplex machine or at the left end of the duplex machine. The drum carries dogs which operate the feed control and power rapid traverse clutches, where such operation is necessary and is not taken care of by the table dogs. When the automatic feed control is provided, there is an additional control lever located near the upper right corner of the door which encloses the drum mechanism. This lever may be set to reengage automatically at the completion of each cycle, but it is usually manually operated so that when the table returns into the loading position, it will stop until the operator has had time to reload the fixture and again throw in the lever to start the automatic cycle. A large variety of cycles may be obtained, including intermittent feed with power rapid traverse in either direction.

The automatic spindle start and stop control is furnished only in connection with the automatic feed control. It is so constructed that the spindle stops whenever the power rapid traverse is engaged and remains stationary until the feed is again engaged. When the spindle reversing unit is applied, the horizontal drive shaft in the base of the machine is equipped with bevel gears and a reverse clutch, so that the spindle can be run in either direction. A lever for reversing this clutch is accessible through a door in the bed. This reversing unit may be applied to either or both heads of duplex machines.

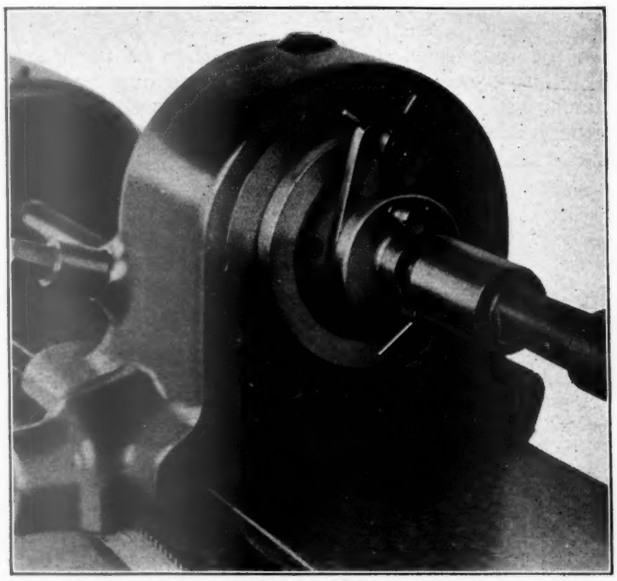


The Pennsylvania's "John Bull"—1831—On exhibition at the Fair of the Iron Horse

Reamer sharpening machine

WHEN sharpening reamers for service where accurate size and good finish are desired, it is usually necessary to hone the reamer cutting edges by hand to obtain the required results. The hand operation introduces the personal equation which is undesirable because of the difficulty in positively controlling the accuracy of the cutting edge. The Barber-Colman Company, Rockford, Ill., has placed on the market a reamer sharpening machine which eliminates hand honing.

The base of the machine is of the box type construction with cross section walls for ribbing. Between these



The position of the reamer in relation to the setting gage and the grinding wheel

sections are openings for housing the motor, the tool compartment for change gears and attachments and the apron carrying the table oscillating mechanism. The machine rests on a three-point bearing which tends to eliminate vibration.

A 2-hp. motor running at 1,150 r.p.m. supplies power for operation. This motor is set on a sub-plate and drives an extended shaft carrying the drive pulley for the wheel spindle, clutch and worm drive shaft. Idler pulleys are provided for keeping the proper tension on the short drives.

A worm drive shaft provided with a cone clutch and mounted on separate bearings engages the grinding wheel drive pulley and is driven by a belt from the motor. The clutch is engaged by a large centrifugal spring and is released by sliding the drive shaft through its entire length. This movement is controlled by a multiple screw shaft and a lever mounted on the front of the machine, convenient to the operator. With this construction it is possible to control the starting and stopping of the platen to within approximately ⅛ in. of the desired position for setting.

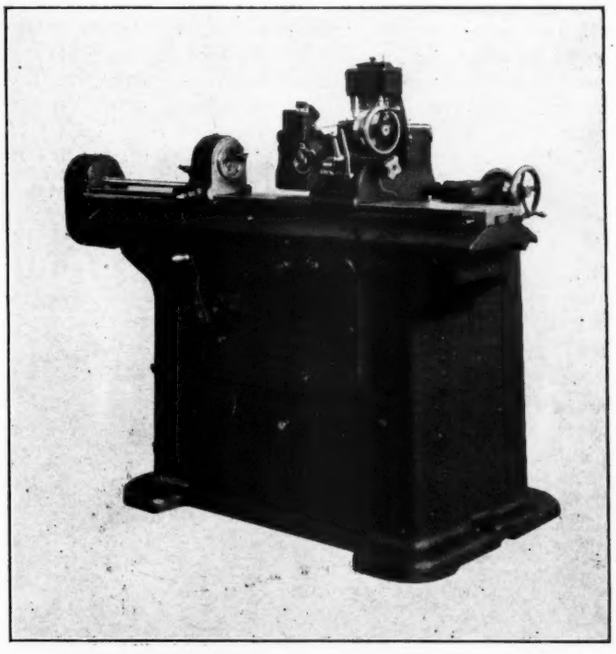
A cam and shaft with a worm wheel and bevel gears are used for reversing the motion for grinding right or left-hand spiral reamers. The cam shaft is provided with a 9-in. diameter, 8-pitch worm wheel which is driven from the drive shaft worm. Universal joints with a telescoping shaft provide the connection between the cam shaft and change gear box.

A gear box mounted on the end of the auxiliary swivel platen provides for automatic indexing. The main platen or slide is provided with one vee slide and one flat slide which assures an accurate line guide. An auxiliary platen is mounted on the main platen pivoting at one end and rolling on flat ball bearings to permit a sensitive movement for following the form of the cam at the other end. This is accomplished by a hardened and ground follow finger.

The head stock is gear driven through a splined shaft connected with the gear change feed box. Sleeve gear construction permits the use of a dead center and allows for the driving of the work dog around it.

The head is also provided with a special driver for determining definite cutting and relief angles. Therefore, it is unnecessary to make special settings for each angle. The tail stock with spring tension on the center and quick release to remove the work is of the conventional type for grinding.

The cam slide block is mounted on the base at the free end of the auxiliary platen. Two slides are provided, one to permit the grinding of back taper as required and the other to vary the length of bevel on the end of the reamer while grinding and without changing the clearances or the form of the nose. This cam slide block is also provided with a trip release



The Barker-Colman reamer sharpening machine

mechanism for taking the work out of its path on the return stroke.

There are four nose beveling cams which are inter changeable and permit of grinding reamers for through hole, bottom hole, hand reaming and cylinder reaming. Special cams can be provided for any reasonable form required on special reamers.

The grinding wheel spindle is of plain adjustable bearing construction throughout and is mounted in a sleeve with a special patented end-thrust mechanism making it possible to grind reamer diameters to unusually close limits.

The feeding in of the spindle is done through rack

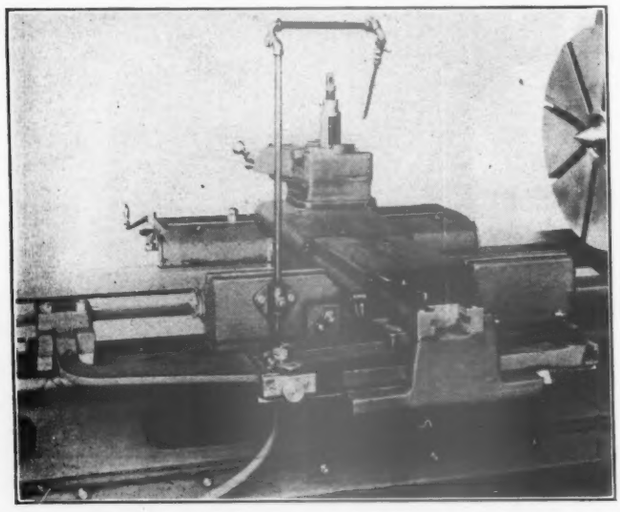
teeth in the sleeve and a pinion shaft which in turn is reduced through a worm and worm wheel, making it possible to move the spindle out of contact and back again with great accuracy. The driving pulley for the spindle is mounted on separate bearings in order to relieve the tension of the belt from the spindle proper. The driving connection is made through a universal jointed shaft.

The grinding wheel used is a 4-in. diameter straight cup wheel which is carefully balanced and trued to avoid all vibration. The same wheel is intended for use in making roughing or finishing cuts. The guard over the wheel is of cast iron construction and is provided with a diamond for dressing the wheel. This is done while the work is in position, avoiding the usual delay in mounting a diamond.

Redesigned 27-in. engine lathe

A TIMKEN roller bearing headstock with a solid six-spline shaft for sliding gears, the drive gears increased in size, greater range of spindle speeds, a new design of taper attachment and improved carriage with wider slides are some of the improvements recently made in the 27-in. Pond Time Saver lathe manufactured by the Niles Tool Works Company, a division of the Niles-Bement-Pond Company, Hamilton, Ohio. The machine is driven by a 20-hp. variable speed, direct current motor with a 1-hp. motor to operate the carriage, rapid power traverse and coolant pump. There are four mechanical spindle speed changes which, in conjunction with the speed variation in the electrical control, provide faceplate speeds ranging from 40 to 220 r.p.m.

In the upper half of the headstock, there are four pairs of Timken tapered roller bearings. In the lower half for either variable speed or constant speed drive, there are only six driving gears, two of these being keyed to the spindle (there are no sleeves on the spindle), the other four being the sliding gears on the spline shaft to effect the speed changes. At each end of the sliding gear shaft a set of six ¾-in. splines is

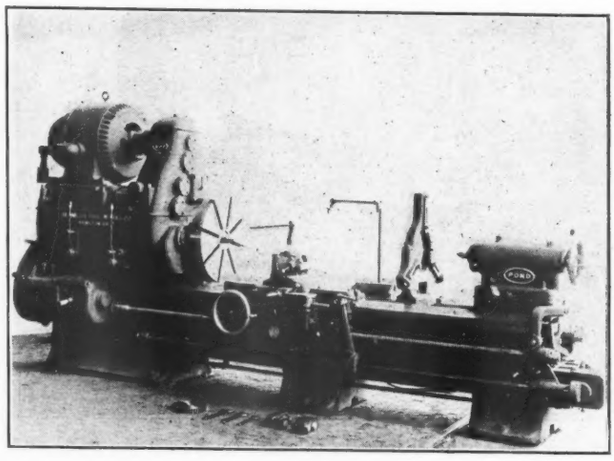


The rigidly constructed taper attachment on the N.-B.-P. Time Saver lathe

cut from the solid and the sliding gears are broached to suit.

The liberal space in the gear box and the small number of gears in the drive have made it possible to utilize drive gears of large proportions. Altogether there are only 12 gears in the head. The arrangement is such that every gear in the drive is supported by double bearings and on the spline shaft the gears carrying the load are always adjacent to a bearing. The motor driving pinion is mounted on its own shaft between double bearings, thus relieving the motor bearings of the driving load. The motor pinion and mating gears have helical teeth; other gears are straight spur type.

In the redesigned machine the position of the drive motor has been reversed. Instead of the motor pinion and mating gears being located at the left side or end of the headstock, they are placed at the right side, or



A Timken roller bearing headstock and an improved carriage with wider slides are two of the redesigned parts of the Niles 27-in. engine lathe

nearest the faceplate. This construction allows the use of motors of various types with frame sizes larger than usual without the disadvantage of the motor extending out toward the faceplate or chuck and obstructing the operator when setting up work. At the same time, the design is such that motors of higher or slower speeds than normal and gear ratios to suit requirements may be utilized without any radical change in design.

A patented feature on this lathe is a jog push button switch which serves the dual purpose of enabling the operator to shift gears and to inch the faceplate or chuck by small increments when setting up or testing work. The switch is located between the gear shift levers and faceplate and is so arranged that the circuit remains closed only so long as the button is depressed; as soon as pressure on the button is released the switch snaps out automatically.

The carriage is equipped with rapid power traverse. Power for this function is taken from a 1-hp. motor at the rear of the machine. The motor is connected through reduction gearing to a screw running the full length of the bed. Corresponding left and right hand nuts, secured in a bracket at the rear of the carriage, rotate on this screw and are connected to a lever at the front of carriage at the operator's working position. When pressure is released, a spring throws the lever

into neutral position. This friction device also acts as a safety feature to prevent damage should the carriage be run against any obstruction due to carelessness. Combined with the rapid traverse movements, the operating lever also controls the longitudinal and cross feed, the feeds being engaged by moving the lever in a horizontal plane so that all power movements in the carriage are controlled by a single lever. The mechanism is so constructed as to prevent the engagement of feed and power traverse at the same time. Furthermore, a safety trigger is also introduced to prevent the operator from accidentally going from the crossfeed to the longitudinal feed and vice versa. There is also an interlock between the feed mechanism and lead screw nut, which arrangement makes it impossible to engage both at the same time.

The cross slide bearing of the carriage has been increased about 20 per cent in width and the tool slide is offset 30 deg. which is of special advantage when cutting vee threads, at the same time preventing interference between the wrench for moving the cross slide and the crank which operates the tool slide.

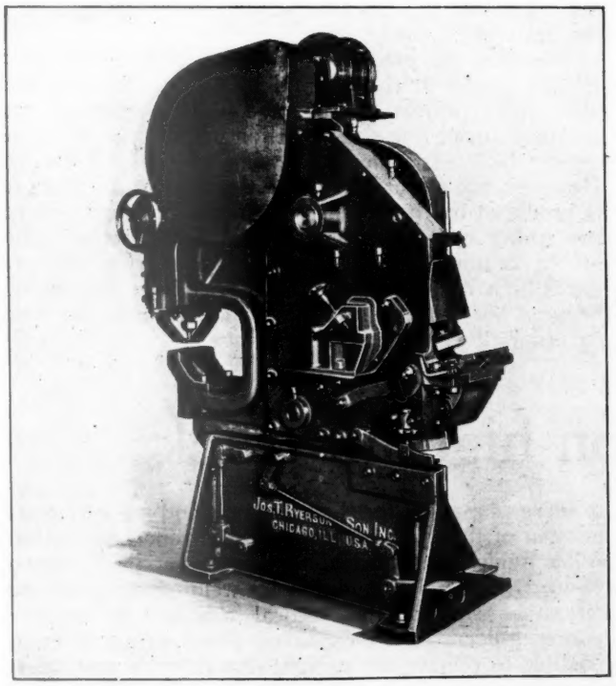
The taper attachment has been made considerably more rigid than in the superseded design. It travels with the bed and is therefore, always ready for use. The end of the cross feed screw is held in a long rectangular block, sliding in a tongued adjustable guide. The slide on the swivelling guide bar is of the inverted dovetail type instead of a rectangular channel which makes the removal of the chips and dirt difficult. The sliding guide block which is fitted to the slide has an adjustment by a taper gib. The bottom slide of the taper attachment is also dovetailed with an adjustment by a taper gib. The design of this member in no way interferes with the setting of a tool or with cross feeding while the taper attachment is in action. The attachment will turn tapers up to 3 in. per foot either side of parallel and tapers up to 18 in. in length may be turned in one setting.

The Time Saver lathe is built in three sizes: 27 in., 30 in. and 36 in., with any desired bed length. The drive may be by direct current variable speed motor or by alternating current constant speed motor or single pulley. In the two latter cases all speed changes are made mechanically, 12 speeds being provided. The general construction of the headstocks for all drives is similar except for additional gears and mechanical brake in the latter for stopping the faceplate, operated by the reversal of the carriage lever on the carriage. The single pulley drive also has a multiple disc clutch controlled from the carriage. The release of the clutch automatically applies the brake. The pulley shaft is mounted on roller bearings and a ball thrust bearing takes the thrust of the clutch engagement.

Ryerson combination shear, punch and coper

A COMBINATION shear, punch and coper that is designed to handle almost all of the varieties of structural shapes used in railroad work, has been placed on the market by Joseph T. Ryerson & Son, Inc., Sixteenth and Rockwell streets, Chicago.

The operation of the punch is not interfered with in any manner by the other units built into the machine.



The Ryerson direct motor driven combination shear, punch and coper

The shearing end of the machine is constructed so that a single slide handles the shearing of angles, bar cutting, plate shearing and coping. The angle shear attachment handles both inside and outside mitre cutting as well as straight shearing. The blades in this unit are made in sections for cheap and easy replacement. The bar cutting blades are located directly below the angle shear blades. These cutters handle both round and square sections and consist of two blades only.

Directly below the bar cutter are located the plate shearing blades. This device handles plates of any width or length and up to ½ in. in thickness. The coping device is built at the shear end of the machine and is extended out from the frame and located at a convenient height for operation. This is a built-in feature so that no time is lost in making special set-ups for this class of work. The coping device is regularly furnished in the vee notch type, but the square notching feature can be provided.

The drive is taken through all steel gears to alloy steel eccentric shafts. The clutches are of the three-jaw type, giving the operator a chance to engage the clutch each third of a revolution of the clutch gear. The main frame of the machine consists of a one-piece alloy steel casting, extending from the feet up to the motor shelf. The bearings throughout are bronze bushed and special care has been taken to provide proper lubrication. The working heights of the various attachments have been made such that the feet of the machine can be placed directly on the floor, thereby eliminating the necessity of building up a concrete pier in order to bring the machine to a proper working height.

The punch attachment has a 15-in. throat and a capacity for punching 13/16-in. holes through ¾-in. material. The plate shear will handle ½-in. material of any length or width. Other capacities include flat bar shearing 6 in. by ⅝ in.; round bars 1¾ in.; square

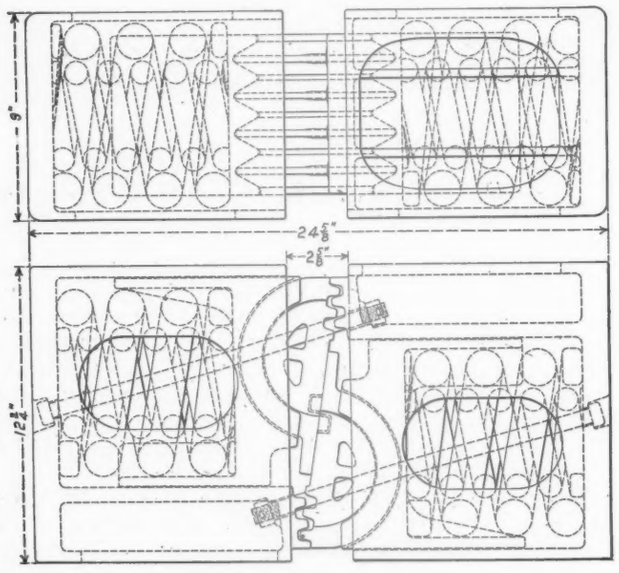
bars 1½ in.; angles 4 in. by 4 in. by ⅜ in.; angles in mitre 3 in. by 3 in. by 5/16 in.; notches in 3-in. by 3-in. by 5/16-in. angles and tees.

The machine makes 35 strokes per minute and can be furnished either direct motor driven as illustrated or arranged for belt drive.

Forsyth friction draft gear

AFTER a number of years of careful tests and development, the Forsyth Draft Gear Corporation, 39 South La Salle Street, Chicago, has placed on the market a new friction draft gear, designed to have high shock absorbing capacity and recoil sufficient to take care of yard conditions.

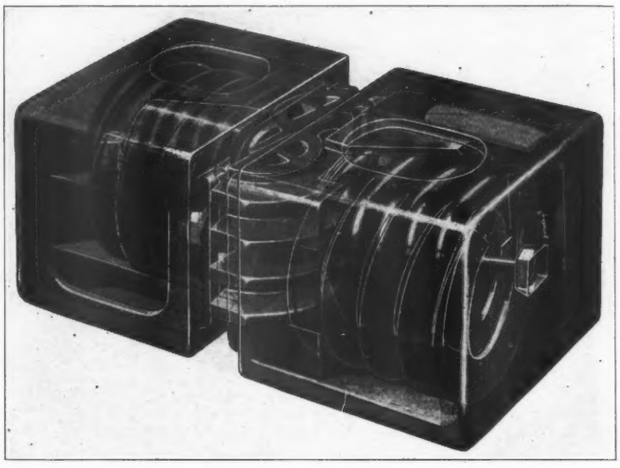
The gear is of sturdy construction, housed in two strong steel castings with a cross sectional area of over 20 sq. in. to take the entire load off the operating parts when the gear has received an over-solid blow, and further prevent the main coil springs from being driven solid. These housing castings also serve the purpose of followers, as the ordinary standard followers



The Forsyth draft gear

used with some gears are not required for this gear. This gear is made to fit the standard American Railway Association draft gear pocket and yoke.

The gear consists of three different castings (two of each), besides the coil springs and tie rods. The springs are standard M. C. B., class "G" springs, set up under initial compression. A total frictional area of 275 sq. in. is provided to assure long life to the wearing parts. The housing castings and levers are made of open hearth cast steel, finished by sand blasting; the spring cap is made of alloy steel, heat treated. Thus all frictional surfaces in contact are of different ma-



Phantom view of Forsyth friction draft gear

terials, producing the best combination to eliminate excessive wear.

The Forsyth friction draft gear is shown assembled in the drawing. The two tie rods serve to hold the gear under initial compression and facilitate the handling of the gear during shipment and applying to the car. The tie rods do not function when the gear is in the draft gear pocket.

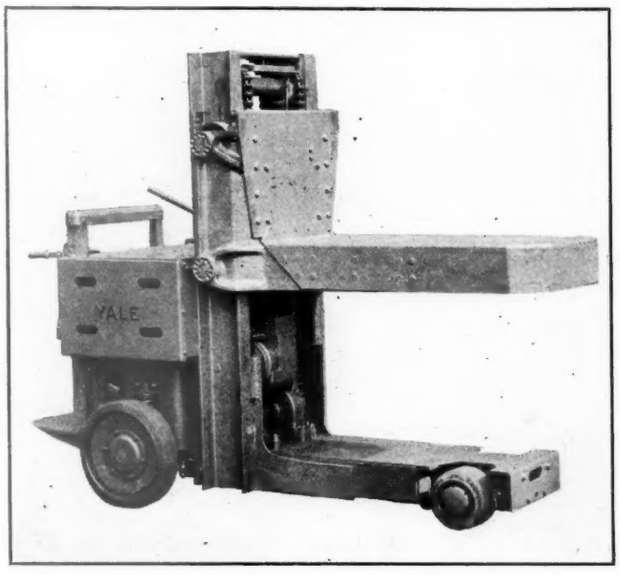
The principle used in building up high resistance to service shocks in this gear is by closing the two class "G" coil springs by leverage. The leverage arm shortens during the closing action of the gear, thus producing high resistance to closing of the coil springs. However, the major portion of the capacity of this gear is produced by the vee-shaped groove bearings between the spring cap and center lever. The circular action of the center lever operating in the spring cap produces high resistance; additional friction is also created between the back wall of the spring cap and the inside curved wall of the housing casting.

The Yale three-ton high lift truck

THE model K25, three-ton high-lift elevating truck has been added to the line of trucks of the Yale & Towne Manufacturing Company, Stamford, Connecticut, in order to fulfill the requirements for increasing loads on electric industrial trucks. The backbone of the frame work is a large gusset plate ½ in. thick, extending from the very forward end of the truck to the small or trailing wheels. This plate is approximately 24 in. in height at the driving wheel axle and in addition to forming the frame work, it provides a yoke to serve as a guide for the drive unit and the spring suspension of the truck. The upright channels or platform roller guides are attached to this gusset plate through ¾-in. rivets, and in addition by welding strips of steel on either side of the vertical channels to serve as pocket guides. By the use of these strips, it is still possible to remove the upright channels for any change or replacement that may be desired. In order to get the necessary stiffness and also in order to provide enough width or surface on which the platform rollers are to

bear, a ship channel has been applied. The structural parts of the truck are joined with 5/8-in. and 3/4-in. rivets, to provide sufficient strength.

The elevating platform is raised and lowered through the medium of a 1½-in. diamond roller chain, passing over a power-driven sprocket at the bottom, and an idler sprocket at the top. Hyatt heavy duty roller bearings are employed in the idler sprocket at the top of the machine to reduce friction to the minimum. The shafts of the lower sheaves run in a bath of oil, which



The Yale Model K25 three-ton high lift truck fully equipped with roller bearings

also serves to lubricate the spur-gear reduction unit. The two ends of the roller chain are attached to the platform through a spring take-up device, which will automatically adjust itself as the chain wears.

The hoisting motor is connected to the spur-gear pinion through a spring ratchet, so arranged that a positive drive is obtained when raising the elevating platform. If, however, the platform is checked in its downward travel, the ratchet merely releases, and causes no injury to the mechanism of the truck. A speed of 7½ ft. per minute is obtained when lifting a full load, and a speed of 19 ft. per minute when raising the empty platform. The lowering speed is 19 ft. per minute loaded or empty.

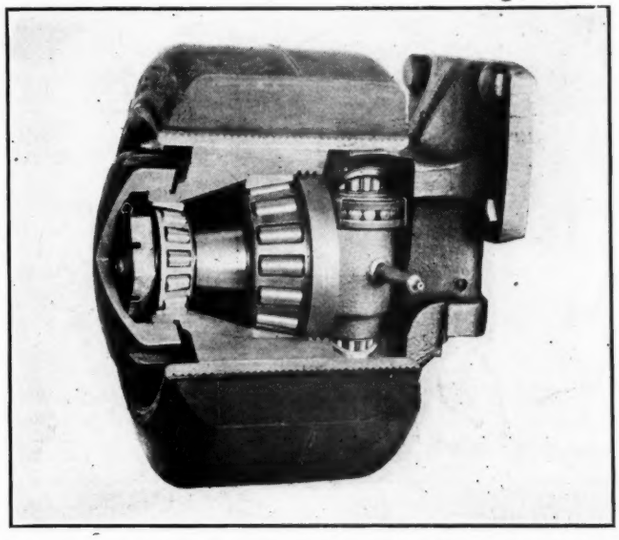
The elevating platform of the truck is supported in the horizontal position by four rollers bearing on the inside of the flanges of the vertical ship channels. These channels have a depth of 9 in. and a flange of 3½ in., so that a relatively large diameter roller with a wide face, is possible. To reduce friction to a minimum the rollers are equipped with Hyatt heavy duty roller bearings, and with a hardened steel thrust washer to take whatever end thrust may occur when lifting loads that are not placed on the center line of the platform. The pins which serve as spindles for the roller bearings are made eccentric, so that by rotating them the platform may be tilted upward or downward to compensate for any wear that may result on the surface of the rollers and on the face of the vertical channels. The platform has an overall width of 27 in., a height of 11 in. and a length of 54 in.

By placing the elevating or hoist unit between the vertical roller channels, all of the available space is utilized, with the result that the overall length of the machine when in operating condition is cut to a minimum. The hoist unit in this position is accessible for any servicing or inspection that may be required, and provides the further advantage that it separates the elevating roller channels a distance sufficient to give a very high degree of visibility for the operator when driving the machine.

The main drive unit is of the double reduction spur-gear type, driving the wheels through totally enclosed universal joints. The entire gear reduction, with its differential and bearings, runs in a bath of oil.

In order to reduce the physical effort necessary to steer a machine of this heavy capacity, the steering knuckle king pins have been fitted with ball and roller thrust bearings which puts the entire weight of the machine on roller bearings. The small wheels are fitted with roller bearings on all the moving parts each wheel assembly containing five bearings, including a thrust bearing on the steering knuckle. A four-wheel steering feature allows a turning radius of 96 in. to the outside edge of the truck.

The design and strength of the joint between the vertical roller channels and the structural frame members, make it unnecessary to have any trusses or structural members reaching diagonally from the top of the roller channels to the operator's back-rest. By omitting



The rear wheel axle and steering knuckle equipped with Timken bearings

these braces, it is possible to leave the top of the battery box clear and permit servicing or watering of the battery, without sliding it out. The battery itself may be removed by hoisting it out of the battery box, or by removing the side plate of the box and sliding it out sideways.

NEW AND USED EQUIPMENT.—Bulletin No. 130, issued by the Hyman-Michaels Company, Chicago, lists new and relaying steel rails, locomotives, cars—passenger and freight—used machinery, steam and electric hoists and equipment.

LUBRICATED PLUG VALVES.—The Barco Manufacturing Company, Chicago, has just completed a new eight-page catalogue, No. 307, covering Barco lubricated plug valves. A special air hoist valve and a steam jacketed valve are also illustrated.

CRANES AND TROLLEYS.—A 44-page, illustrated catalogue giving complete specifications, clearances, list prices and other crane and trolley information of value to engineers and users of crane and trolley equipment, has been issued by H. D. Conkey & Co., Mendota, Ill.

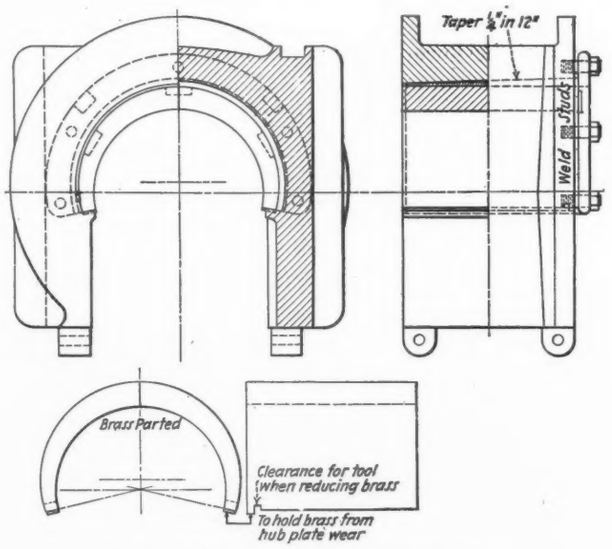
Driving box with adjustable brass

A NEW driving box with adjustable brass, developed recently and now being tried on a number of roads, is known as the James driving box, supplied to the railroads by Morris B. Brewster, Inc., 332 South Michigan Boulevard, Chicago. The principal feature of this driving box is that wear in the brass crown bearing may be taken up and the brass adjusted or renewed without the time and labor cost involved in taking down binders, dropping wheels, removing grease cellars, etc. The driving box is designed to prevent lost motion in the main bearings, to increase the life of these bearings and to reduce rod pounding and consequent rod and frame breakage. It is said to permit wearing driving box brasses down to a low limit of thickness before scrapping them.

The construction of the James driving box with adjustable brass is clearly indicated in the drawing. The crown brass itself, in two parts, extends somewhat below the center line of the journal giving more than the usual bearing surface to resist thrust. The brass is held firmly in place by an adjustable cast steel taper wedge.

This wedge has a taper of ¼ in. in 12 in., a corresponding taper being cut in the driving box. As soon as wear or driving box pound develops, the stud nuts are backed off, the taper wedge and crown brass removed, and the thin edges of the two sections planed off the required amount, depending upon the wear. The brass and wedge are re-applied, the latter being drawn up until the brass is once more held firmly in place and the brass fits the journal accurately. All of this work can be done without dropping the wheels or removing the driving box from the axle journal for renewals.

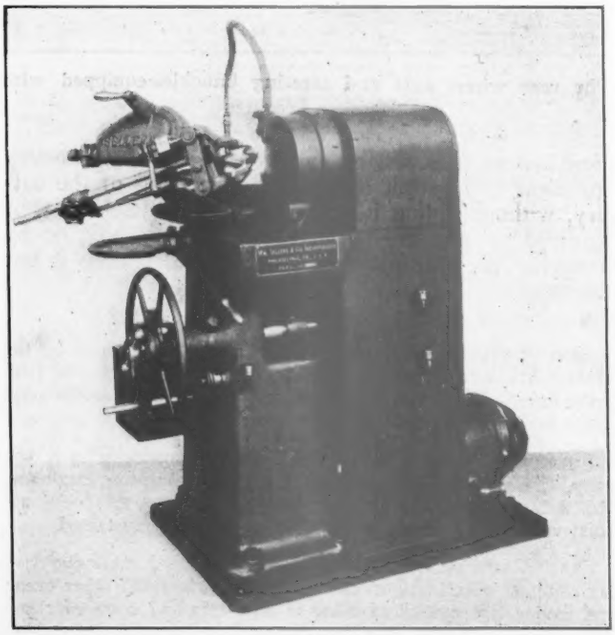
It will be observed that the studs are threaded and then welded into the driving box face as a precaution against their backing out. Two lugs on the brass assure its remaining in the proper position while the wedge is being tightened.



James driving box with adjustable brass

Machine for grinding two-lip flat and twist drills

THE No. 2-A drill grinding machine manufactured by the William Sellers & Company, Inc., Philadelphia, Pa., is designed for two-lip flat and twist drills from 5/16 in. in diameter to 3 in. in diameter. With a special set of jaws, it will also grind three-lip drills from ¾ in. to 2 9/16 in. in diameter.



The Sellers No. 2-A motor-driven drill grinding machine

The drill is held in a chuck at the correct angle with the edge of the drill against the grinding wheel. The oscillation of the chuck then produces a cutting edge which is theoretically correct.

The emery wheel is carried on a ground spindle of high carbon steel. The spindle bearings are made of special hard bronze and are readily adjusted for wear. The emery wheel and spindle are mounted on a swing frame which is operated by a hand lever. This moves the wheel to and fro in a plane normal to the axis of the spindle. This operation facilitates the grinding and keeps the working face of the emery wheel straight.

The chuck holds the drill between hardened steel jaws on the flutes near the cutting edge where it is to be ground. The shank end of the drill is held on a center adjustable for the length of the drill. This method of holding the drill assures the point being ground successfully, as any bend in the drill or shank will not affect the accuracy of the cutting edge.

The chuck oscillates on hardened steel centers, one of which is adjustable for wear. The chuck is balanced by a counterweight which may be set for different weights of drills. This adjustment is not necessary, but will be found advantageous where a large number of the same size of drill are to be ground.

The grinding wheel is covered by a cast iron guard, allowing only a small portion of the wheel to be exposed. The guard is of such a shape that the water is carried down to the pan without splash. The pump supplies

an abundance of water, which eliminates all risk of drawing the temper of the drill. The wheel may be removed or replaced quickly and with comparatively little trouble on the part of the machinist.

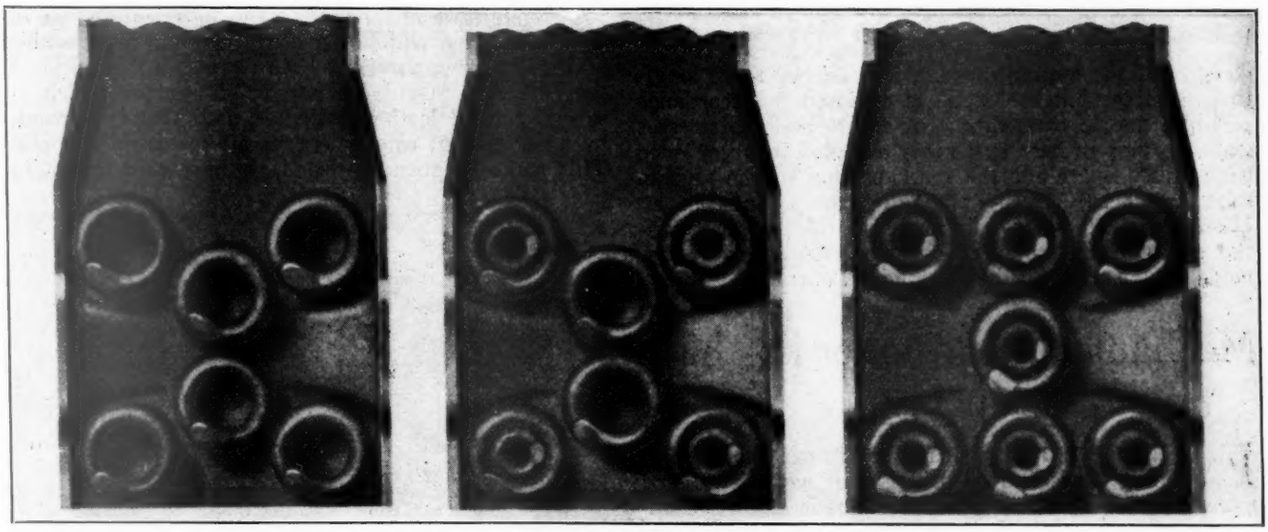
The chuck is adjustable to grind any angle of drill point from 90 deg. to 130 deg. included angle. Standard equipment includes one set of chuck jaws for all sizes of two-lip twist drills within the range of 5/16 in. to 3 in. and an extra set of jaws for chucking two-lip flat drills for the same range. If desired, a special set of jaws may be furnished to chuck three-lip twist drills from ¾-in. to 2 9/16 in., inclusive.

No parts have to be substituted in changing from one size drill to another, and it is not necessary to employ a skilled mechanic to operate the machine. The machine grinds on the flat surface of the wheel, so that a line contact is made and the greatest amount of metal will be removed with the least expenditure of power and without clogging the wheel. The machine is furnished either belt driven or motor driven. In the latter case the motor is mounted on a substantial base plate with the machine, and the armature shaft of the motor is supported at its outer end in the base of the machine. A large guard protects the motor and belt.

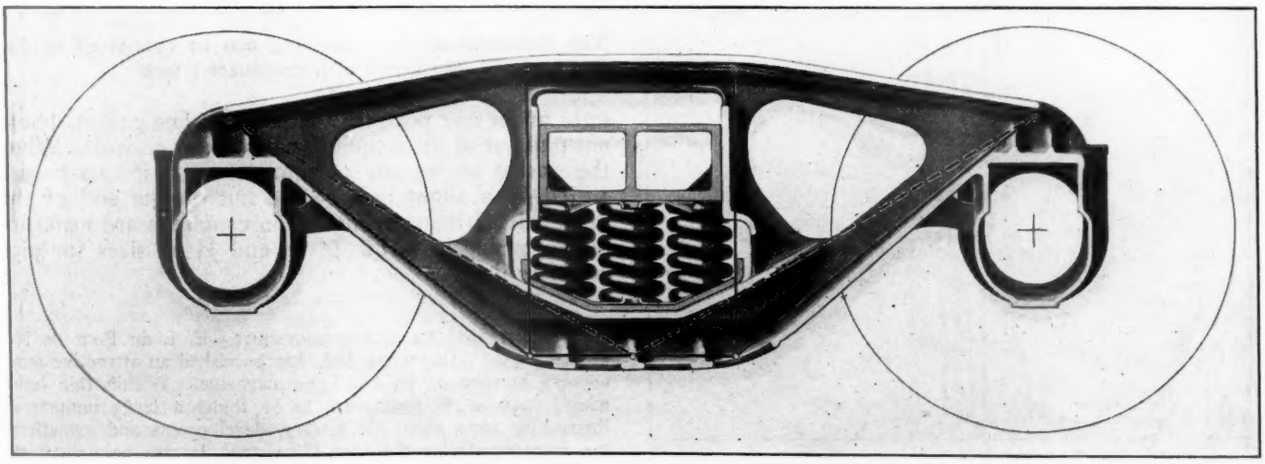
Symington double truss side frame

COMMERCIAL designs of cast steel truck side frames for freight equipment usually follow the lines of a simple three-panel truss, the middle section of the lower or tension truss member serving also as a partially restrained beam carrying through the springs one-half the bolster load. This middle section is, therefore, subject to local deflection from the vertical loads and as the depth of this section as a beam is limited by the standard location of the spring plank and the standard rail clearance, the increased span length between columns required for heavy capacity cars and especially for an increased number of springs, produces bending moments of considerable magnitude.

In the new double truss side frame recently placed on the market by the Symington Company, 250 Park avenue, New York, the bending moments in and the deflection of the center portion of the bottom member have been reduced by supporting the middle section at its central point, thereby substituting two spans each of



Beginning at the left, the springs in the Symington 40-ton, 50-ton and 70-ton double truss side frames



A longitudinal sectional view of the side frame showing the division of the tension member

half the original length. This center support is secured by designing the frame with a theoretically divided tension member, the two inclined halves of the middle portion intersecting on the transverse center line of the frame, while the outer or embracing portion of the tension member follows the usual three panel contour. This division of the tension member is shown in the longitudinal sectional view of the frame.

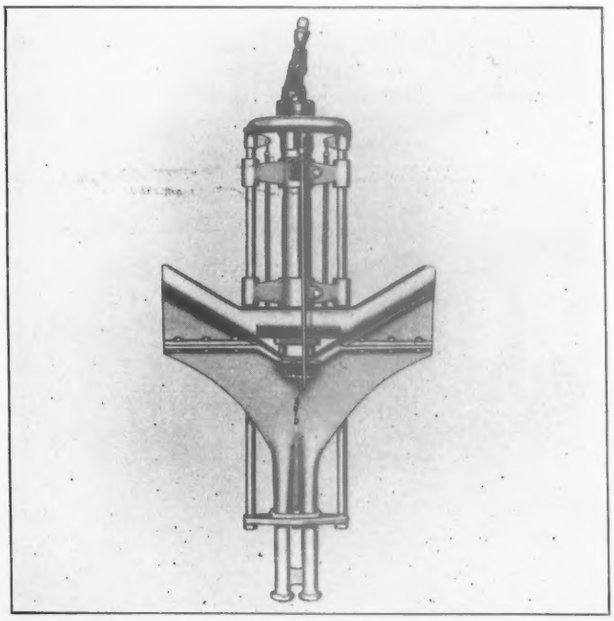
Practical considerations prevent an actual physical

The Symington double truss side frame

division of the tension member into two or three longitudinal pieces but the metal is disposed in accordance with the double truss theory of design and the stresses and behavior of test specimens are also in accordance therewith. Space for the inner portion of the tension members is secured by arranging the springs in an H-shaped group so that the width of the flat portion of the spring plank seat need only be sufficient to accommodate one spring on the longitudinal axis of the frame.

Mechanical floor nailer has high capacity

FLOOR nailers adaptable for use in car shops, shipbuilding yards and on bridge floor work, are being manufactured by the Duplex Automatic Nailer Com by air pressures of 90 to 120 lb. per sq. in., and are designed to drive into hard wood 20 to 60-penny spike nails at the rate of 1,200 to 1,800 per hour. The weight of a nailer complete with hammer is 78 lb.

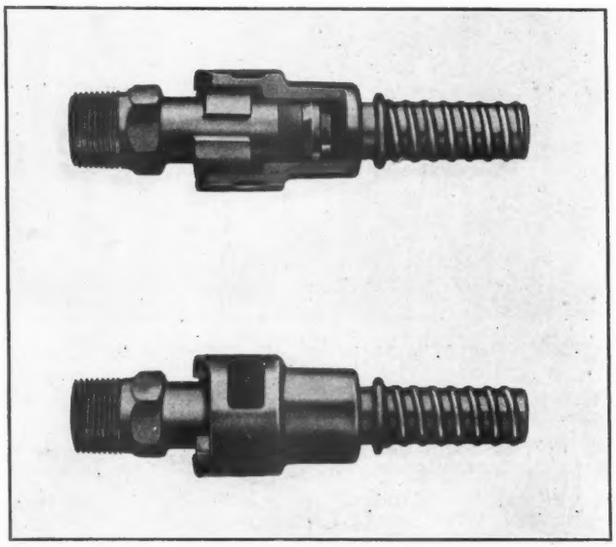


A magazine-fed pneumatic nailer which drives 20 to 60-penny spikes at the rate of 1,200 to 1,800 an hour

The air hammer, which is mounted on two crossheads, is movable up and down on the guide rods, the weight being taken by springs. When the crosshead assembly is drawn to its extreme upward position, a trip of an automatic feed mechanism is opened, allowing two nails to enter, one in each of two nail pockets. The crosshead assembly is then lowered until the nail sets rest on the heads of the nails. Air pressure is then applied by the operator. Two 20 to 60-penny nails can be driven simultaneously in approximately three seconds. This period includes the time required for the complete driving operation and moving the nailer from one position to another along the floor.

Air hose coupling without loose parts

AN air hose coupling that can be connected or disconnected with one-quarter turn and made without springs or loose parts has been placed on the market by the Robinson Machine Company, Muskegon, Mich. A special treated leather gasket is used that is expanded by a vee-shaped ring when the air pressure is applied. This makes a pressure-seated air hose coupling that is



The Robinson air hose coupling can be connected or disconnected with one-quarter turn

tight under any pressure conditions. The gasket should not pull out of the coupling, nor stick or corrode. When the gasket shows any perceptible wear, it can be adjusted by a slight turn of the nut on the end of the male half of the coupling. The couplings are made interchangeable in ⅜ in., ½ in. and ¾ in. sizes for pipe and hose lines.

DU PONT HISTORY AND DEVELOPMENT.—E. I. du Pont de Nemours & Co., Wilmington, Del., has published an attractive anniversary number of its Du Pont magazine. Within this issue, which contains 48 pages, are to be found a large number of interesting facts about the history, development and growth of the company during the past 125 years. It also points out the intimate relationship existing between the apparently wholly unrelated products manufactured by the company.

News of the Month

TEXAS & PACIFIC.—A contract has been let to the Austin Brothers Construction Company, Austin, Tex., for the construction of a steel shop building at Big Spring, Tex., to replace a building destroyed by fire. Outside dimensions of the shop will be 42 ft. by 146 ft. with an addition of 14 ft. by 62 ft.

The Committee on Locomotive Design and Construction requests suggestions

The Committee on Locomotive Design and Construction of the Mechanical Division of the American Railway Association, in its report to the annual meeting held this year at Montreal, made certain recommendations under the general subject of design of fundamental parts of locomotives. The Committee wishes to enlarge on this subject during the coming year with a view of ultimately having definite standards for as many of the fundamental parts of locomotives as possible and is asking for suggestions as to what parts should be undertaken for standardization during the coming year. Any suggestions should be submitted to the offices of the A. R. A., located at Chicago.

Test laboratory inspection

In order to afford all interested an opportunity to inspect the methods of procedure at both the air brake tests and the draft gear tests now being conducted by the American Railway Association, Mechanical Division, at Purdue University, Lafayette, Ind., a day, Friday, November 11, has been set aside for general inspection. Unofficial tests will be conducted in the air brake research laboratory under the direction of H. A. Johnson, director of research, and in the draft gear test laboratory under the direction of Dean A. A. Potter, Professor G. A. Young and Professor C. A. Gray, who, with their associates, will conduct visitors through the laboratories and explain all matters in question. Members of the Mechanical Division and others will thus be given an excellent chance to familiarize themselves with the work being done to develop improvements in freight train brakes and draft gears.

Mechanical Division adopts changes in arch bar trucks

Five propositions pertaining to arch bar trucks presented at the annual meeting of the Mechanical Division of the American Railway Association by the Committee on Car Construction, have been submitted to letter ballot and adopted by a small margin over the required two-thirds of the votes cast. On the five propositions, from 272 to 295 members, representing from 1,897,055 to 2,087,685 cars owned or controlled, voted in favor of the proposed changes in arch bar trucks, with from 46 to 69 members representing from 500,668 to 691,298 cars opposing and 65 members representing 131,401 cars not voting. In addition to the adoption of the changes to arch bar trucks, the association has approved as recommended practice, specifications pertaining to air, steam, cold water and fire hose and liquid paint dryer, proposed by the Committee on Specifications and Tests for Materials and the standard sizes of locomotive driving axles, engine truck and trailer axles, proposed by the Committee on Locomotive Design and Construction. Fourteen changes in the loading rules have been unanimously adopted by the association. The proposals of the Committee on Wheels with respect to gages, and of the Committee on Locomotive and Car Lighting and Brakes and Brake Equipment with respect to details of lettering were adopted by an overwhelming majority.

Meetings and Conventions

A.S.M.E. annual meeting program includes many railroad papers

The program for the annual meeting of the American Society of Mechanical Engineers which will be held in the Engineering Societies' Building, 29 West Thirty-ninth street, New York, December 5 to 8, inclusive, includes a large number of papers on subjects of interest to mechanical department men. The Railroad Division is scheduled for an all-day session, Tuesday, December 6, beginning at 9:30 a. m. Six papers are to be presented during the session of the Railroad Division which include the annual report of progress in railway mechanical engineering. In addition, the Oil and Gas Power Division will present a paper on Diesel locomotives during its session on Thursday afternoon, December 8. The following is a list of the papers and events which have been selected from the program of the annual meeting as being of interest to railroad mechanical department men:

TUESDAY, DECEMBER 6—MORNING

The Development of Hydraulic Feeds on Multiple Drilling Machines, by R. M. Galloway.
Hydraulic Feeding Mechanism for Milling Machines, by S. Einstein and H. Ernst.
Vibration of Bridges, by S. Timoshenko (by title).
The Motor Truck and L. C. L. Freight, by F. J. Scarr.
Back Pressure and Cut-Off Adjustment for the Locomotive, by Thos. C. McBride.

AFTERNOON

Symposium on Plant and Equipment Maintenance:
- Maintenance of Machine Equipment, by William Hartman.
- Plant Maintenance and Return on Capital Investment, by W. H. Chapman.
- Maintenance of Shop Equipment, by J. R. Weaver.
- Maintenance of Shop Equipment, by C. S. Gotwals.
- Plant maintenance, by Geo. H. Ashman.

Heating and Ventilating of Passenger Cars, by Edward A. Russell.
Can Accident Prevention be Reduced to a Science? by Thos. H. Carrow.
Address by W. E. Wickenden on What the National Engineering Societies can do for Engineering Education.

EVENING

Presidential Address and Reception.
Award of Melville Medal to L. P. Alford.

WEDNESDAY, DECEMBER 7—MORNING

The Development of Machine Tools from a Users' Viewpoint, by F. C. Spencer.
Materials Handling as an Aid to Production, by Frank L. Eidmann.
Costs of Operation and Savings Effected by Electric Industrial Trucks and Tractors, by C. B. Crockett and H. J. Payne.

AFTERNOON

Education and Training for the Industries:
- Apprentice Training for Draftsmen, by C. J. Freund.
- Principles of Apprenticeship Organization, by Ben S. Moffatt.
- Reports from Bureau of Standards and M. I. T.

Ladies' Tea.

EVENING

Annual Dinner.

THURSDAY, DECEMBER 8—AFTERNOON

Boiler Feedwater (Joint Research Committee on Boiler Feedwater Studies for Power Division):
- Progress Report of Executive Committee with Outline of Plan and Scope for Future Work, by S. T. Powell.
- Progress Reports of Sub-Committees of Joint Research Committee on Boiler Feedwater Studies:
  - Design and Operation of Deconcentrators and Continuous Blow-Down Apparatus, by R. C. Bardwell (Sub-Committee No. 1).
  - Water Softening by Chemicals, with Special Reference to Combined Systems, by C. R. Knowles (Sub-Committee No. 2).
  - Studies on Priming and Foaming of Boiler Waters with Special Reference to Railroad Practice, by C. W. Foulk (Sub-Committee No. 3).
  - Corrosion of Boilers and Appurtenances and Plan and Scope of Future Work, by F. N. Speller (Sub-Committee No. 5).
  - The Effect of Industrial Wastes on Boiler-Feedwater Problems and Condenser Operation, by V. B. Siems (Sub-Committee No. 7).
  - Standardization of Water Analyses with Recommendations for the Determination of Dissolved Oxygen Co., and Hydrogenion Concentration, by Harold Farmer (Sub-Committee No. 8).
  - Bibliography of Boiler Feedwater with a Review of the Work

During the Past Year, by George A. Stetson, (Sub-Committee No. 9).
Diesel Locomotives, by R. Hildebrand.
Henry Robinson Towne Lecture:
The Relationship Between Industry and Taxation—An Economist's Views of a Sound Program for American Business in the Field of Taxation, by Prof. T. S. Adams.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 13 to 20, 1928, inclusive, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York. Meeting November 15 with Metropolitan Section, Engineering Society's Building, New York. Paper on high pressure steam locomotives by J. M. Taggart, consulting engineer, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, Hotel Sherman, Chicago, October 25-28.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—Maynard Rodgers, secretary, care Y. M. C. A., Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. building. Next meeting Nov. 14. General discussion on billing, repair cards.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting November 14. Samuel Dunn, editor *Railway Age*, will give a straight talk to car men.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—(See Railway Car Department Officers' Association.)

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central building, Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—Wiliam Hall, 1061 W. Wabash Ave., Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting November 10 at Palace Hotel, San Francisco. Third annual associate members' night.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt railway, Clearing Station, Chicago.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August. Next meeting Nov. 15. Motion picture "The Romance of Power" will be shown.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month. Terminal Hotel bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting, November 21. A. W. Bruce, designing engineer, American Locomotive Company will present a paper "The Locomotive Yardstick."

Supply Trade Notes

John F. Schurch, chairman of the board of directors of Manning, Maxwell & Moore, Inc., New York, has resigned.

The Standard Coupler Company has removed its office from 110 East Forty-second street to 420 Lexington avenue, New York City.

The Jones & Laughlin Steel Co. has moved its Chicago branch into its new two-story warehouse and office building at 2250 W. Forty-seventh street.

The Whiting Corporation, Harvey, Ill., has appointed J. F. Shouse & Co., Louisville, Ky., its sales representative for Kentucky and the southern part of Indiana.

The Morse Twist Drill & Machine Co., New Bedford, Mass., has opened a store at 92 Lafayette street, New York City, where it has put in a complete stock of its products.

H. B. Wilson has been appointed southwestern sales manager of the railroad division of the Morton Manufacturing Company, with headquarters at 915 Olive Street, St. Louis, Mo.

The Air Reduction Co., Inc., 342 Madison avenue, New York, has purchased the oxygen plant, equipment and entire business of the New England Compressed Gas Company, Boston, Mass.

Malcolm S. Simpson, Louisville, Ky., has been appointed direct sales representative for the Morton Manufacturing Company, railroad division, in the territory surrounding Louisville.

W. R. Tomlinson, formerly vice-president of the Billings & Spencer Co., Hartford, Conn., has been appointed works manager of the Buffalo plant of J. H. Williams & Co., Buffalo, N. Y.

The American Manganese Steel Company, Chicago, has purchased the foundry of the American Brake Shoe & Foundry Company at Burnside, Ill., and will begin operations in it on January 1, 1928.

J. C. Fitzpatrick has been appointed district manager of sales of the Chicago Pneumatic Tool Company, with headquarters at Cleveland, Ohio, to succeed J. L. Westenhaver, who has resigned to enter business for himself.

J. R. Matlack, treasurer of S. F. Bowser & Co., Ft. Wayne, Ind., has been appointed treasurer and general manager of the S. F. Bowser & Co., Ltd., Toronto, Ont., and will be succeeded by E. D. Eggimann, the secretary.

The Rollway Bearing Company, Inc., Syracuse, N. Y., has opened a sales office at 956 Leader Building, Cleveland, O. R. D. Faris has been appointed Cleveland district representative with headquarters at the above address.

Joseph T. Ryerson & Son, Inc., Chicago, has taken over the distribution of the Foote-Burt line of drills to the railroads, which includes machines for single and multiple drilling such work as mud rings, flue sheets, etc.

M. L. Bardach, formerly president of the Bardach Iron & Steel Company, Norfolk, Va., has been appointed sales manager for the steam railroad department of the Columbia Machine Works & Malleable Iron Company, Brooklyn, N. Y.

The Kearney & Trecker Corporation, Milwaukee, Wis., has let a contract for a new 75 ft. by 176 ft. addition to its plant, providing 13,400 sq. ft. of floor space to take care of its increasing business. Several new machine tools have also been recently purchased.

Robert E. Kinkead has resigned as chief engineer, welding division, of the Lincoln Electric Company, Cleveland, Ohio, to engage in consulting engineering in connection with electric arc welding. Mr. Kinkead's office is located at 3030 Euclid avenue, Cleveland, Ohio.

Charles C. Phelps, combustion engineer, has removed his office from Paterson, N. J., to Room 528, 30 Church street, New York, where he will continue to represent the Power Plant Equipment Company, the Uehling Instrument Company, the A. W. Cash Company, and the Williams Gage Company. Mr. Phelps has

also been appointed sales engineer of the Hill Clutch Machine & Foundry Company, Cleveland, Ohio.

J. H. Somerville, until recently connected with the Philadelphia office of the Reading Iron Company, Reading, Pa., has been appointed associate of W. J. White, district sales representative of the Baltimore office. Mr. Somerville will represent Reading Iron Company in the south. C. M. Barr succeeds Mr. Somerville in Philadelphia.

Harry J. Steinbreder, president of the Fulton Iron Works, St. Louis, Mo., has been elected chairman of the board of directors of the Foos Engine Company, Springfield, Ohio, and George Foos has been elected president. The Fulton Iron Works has acquired an interest in the Foos Engine Company, which will permit the grouping of the sales of the products of both companies; each company, however, retains its separate identity.

Horace A. Beale, Jr., president of the Parkesburg Iron Company, Parkesburg, Pa., died recently at the age of 57. Mr. Beale was born at Hibernia, Pa., and began work with the Pennsylvania Steel Company, Steelton, Pa., in 1892, and in 1893 he entered the employ of the Parkesburg Iron Company where he became vice-president in 1898 and president in 1900. During his administration of the Parkesburg Iron Company, a tube mill for manufacturing charcoal iron into boiler tubes was built in 1908.

Charles F. Quincy, chairman of the board of directors of the Q. & C. Company, died on October 1, 1927, at his summer home, Center Harbor, N. H., after a prolonged illness. Mr. Quincy was born in Newton, Mass., on July 16, 1856. From 1886 he was in the railroad supply business, first operating as the Dunham Manufacturing Co., and later as the Q. & C. Company; he was also connected with and active in several other enterprises and was interested in forestry work.

Charles F. Quincy

Harris C. Macklin, until about a year ago sales agent of the Railway Steel Springs Company and the Southern Brass Works, at Norfolk, Va., and formerly for about eight years, previous to 1913, purchasing agent of the Seaboard Air Line, died suddenly on October 8, at the age of 71.

Timken purchase of British interests

The Timken Roller Bearing Company, Canton, Ohio, and M. B. U. Dewar, of London, England, have together purchased from Vickers, Ltd., all of the capital stock of British Timken, Ltd. This purchase gives Timken complete control, throughout the world, of the manufacture and sale of Timken bearings.

Mr. Dewar, who now assumes active management of British Timken affairs, was until recently managing director of the Metropolitan Carriage, Wagon & Finance Co., Ltd., of Birmingham, England, and he was also a member of the Industrial Management Board of Vickers, Ltd.

The Birmingham plant of British Timken, Ltd., is being enlarged, and new machinery and equipment have been installed. Officers of British Timken, Ltd., are now at the Canton, Ohio, works making final arrangements for the immediate establishment of factories in France and Germany. Previously the British Timken, Ltd., has operated for many years under license from the Timken Roller Bearing Company. Its products are used in British touring cars, motor trucks, buses and motorcycles.

Personal Mention

General

A. J. POOLE has been appointed mechanical assistant of the Tennessee Central, with headquarters at Nashville, Tenn.

KARL BERG, shop superintendent of the Pittsburgh & Lake Erie at McKees Rocks, Pa., has been appointed assistant superintendent of motive power, with headquarters at the same point, succeeding M. A. Smith. Mr. Berg was born in Sweden, in December, 1881. He became a machinist helper on the Pittsburgh & Lake Erie in May, 1903; machinist apprentice in May, 1904, and mechanical draftsman in the mechanical engineer's office at Pittsburgh, Pa., in May, 1908. He accepted a position with the H. K. Porter Locomotive Company, Pittsburgh, as a locomotive designer in November, 1909, returning to the mechanical engineer's office of the P. & L. E. as a draftsman in July, 1911. He was later promoted to chief draftsman, and in June, 1917, was appointed mechanical engineer. He was promoted to shop superintendent at McKees Rocks in September, 1920.

Karl Berg

Mr. Berg was educated in the Public schools of Sweden; attended the New York Central apprentice school while serving as an apprentice, and, after completing the apprentice course, continued until 1913, studying mechanical engineering in the evening classes of the School of Applied Science, Carnegie Institute of Technology, Pittsburgh.

RALPH W. ANDERSON, who has been appointed superintendent of motive power of the entire system of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., was born in Madison county, Iowa, on May 6, 1877, and entered railway service as a machinist apprentice on the Des Moines Union at Des Moines, Iowa, in January, 1892. After five years with the Des Moines Union Mr. Anderson became a machinist on the Chicago, Rock Island & Pacific, later being advanced through the position of assistant roundhouse foreman to roundhouse foreman. His service with the Milwaukee began in September, 1906, when he became a machinist at Mitchell, S. D. In the following year he was promoted to assistant roundhouse foreman at Mitchell, where he remained until September, 1907, when he was transferred to the Idaho division as a machinist. Mr. Anderson was advanced to mechanical foreman of the Idaho division in June, 1908, and from May, 1909, to November, 1912, he served as roundhouse foreman at Avery, Idaho, and Miles City, Mont. At the end of that time he was promoted to master

R. W. Anderson

mechanic, with headquarters at Miles City, where he remained until June, 1918, when he was again promoted to assistant superintendent of motive power of the Eastern lines, with headquarters at Milwaukee. In June, 1920, he was advanced to superintendent of motive power of the Eastern lines, a position he held until his jurisdiction was extended to cover the system.

H. L. Harvey, assistant superintendent of motive power and machinery of the Chicago & North Western, has been appointed superintendent of motive power, with headquarters at Chicago, succeeding E. B. Hall. Mr. Harvey was born on July 9, 1874, and entered the employ of the Chicago & North Western on September 11, 1899, as a locomotive fireman. He was promoted to locomotive engineer in December, 1906; appointed traveling fireman in January, 1907, and from the latter date until April, 1912, was traveling fireman, trainmaster and assistant road foreman of engines. In August, 1917, he was promoted to master mechanic of the Iowa and Minnesota divisions with headquarters at Belle Plaine, Iowa; in August, 1918, promoted to general fuel supervisor with headquarters at Chicago, and in December, 1919, was appointed assistant superintendent of motive power and machinery.

H. L. Harvey

Percy Boyle, road foreman of engines of the New York Central at East Buffalo, N. Y., has been promoted to supervisor of fuel and locomotive performance, with the same headquarters.

M. A. Smith, assistant superintendent of motive power of the Pittsburgh & Lake Erie at McKees Rocks, Pa., has been appointed superintendent of motive power, with headquarters at Pittsburgh, Pa., succeeding D. J. Redding, retired. Mr. Smith was born at Norwalk, Ohio, on September 7, 1872. He entered the service of the Wheeling & Lake Erie as a locomotive fireman on August 29, 1890, and was promoted to locomotive engineer in 1896. In 1899 he left the employ of the W. & L. E. and in March, 1900, began his career on the Pittsburgh & Lake Erie as a locomotive inspector. In June, 1901, he became traveling fireman; in November, 1902, enginehouse foreman; in June, 1904, general foreman at Glassport, Pa.; in December, 1912, general foreman at East Youngstown, Ohio; in September, 1917, trainmaster, and in June, 1923, assistant superintendent of motive power at McKees Rocks.

M. A. Smith

H. H. Hummel, chief clerk to the general superintendent of motive power of the Southern Pacific, has been promoted to assistant to the general superintendent of motive power, with headquarters at San Francisco, Cal.

Charles M. House, general car foreman of the Chicago & Alton, with headquarters at Bloomington, Ill., has been promoted to superintendent of motive power and equipment, with headquarters at the same point. He succeeds George W. Seidel who retired on October 20 because of ill health.

Master Mechanics and Road Foremen

W. W. Shoemaker has been appointed assistant road foreman of engines of the Virginian division of the Seaboard Air Line, with headquarters at Raleigh, N. C., succeeding W. M. Moore.

G. P. Trachta, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Omaha, Neb., has been transferred to the Galesburg division, with headquarters to be at Galesburg, Ill.

C. E. Brogdon, master mechanic of the Atlantic Coast Line, at Moncrief, Jacksonville, Fla., has been transferred in the same capacity to Southover, Savannah, Ga., succeeding J. W. Reams, who has been assigned to other duties.

G. T. Callender, master mechanic of the Missouri Pacific at Falls City, Neb., has been transferred to the Eastern division with headquarters at Jefferson City, Mo., to replace D. W. Cunningham, who resigned on October 1.

W. T. Abington, master mechanic of the Little Rock division of the Missouri Pacific, with headquarters at McGehee, Ark., has been transferred to the Southern Kansas division, with headquarters at Coffeyville, Kan., succeeding C. R. Kilbury.

George C. Jones, general road foreman of engines of the Atlantic Coast Line, at Jacksonville, Fla., has been appointed master mechanic with headquarters at Moncrief, Jacksonville, Fla., succeeding C. E. Brogdon. The title of general road foreman of engines has been abolished.

Shop and Enginehouse

F. F. Hayes, blacksmith foreman of the Illinois Central at Memphis, Tenn., has been transferred as blacksmith foreman to Paducah, Ky.

H. E. May, boiler foreman of the Illinois Central at Vicksburg, Miss., has been appointed general boiler foreman, with headquarters at Paducah, Ky.

Harry Courtney, mechanical engineer of the Pittsburgh & Lake Erie at Pittsburgh, has been appointed shop superintendent, with headquarters at McKees Rocks, Pa., succeeding Karl Berg. Mr. Courtney was born at Pittsburgh on January 26, 1891. He attended the public schools of Pittsburgh and the Carnegie Institute of Technology, and on June 1, 1913, entered the service of the Pittsburgh & Lake Erie as a draftsman in the office of the mechanical engineer at Pittsburgh. On June 9, 1917, he was promoted to the position of chief draftsman, and on September 1, 1920, was appointed mechanical engineer with headquarters at Pittsburgh.

H. Courtney

Car Department

C. E. Wood, car foreman of the Union Pacific at Kansas City, Kans., has been transferred to Ogden, Utah.

E. A. Danielson has been appointed coach shop foreman of the Chicago, Rock Island & Pacific, with headquarters at Shawnee, Okla.

W. M. Moore, assistant road foreman of engines of the Virginia division of the Seaboard Air Line, with headquarters at Raleigh, N. C., has been appointed supervisor of motor car operation.